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Amphibians and Reptiles from Northern Departamento Loreto, Peru: Taxonomy and Biogeography

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TABLE OF CONTENTS

Abstract	329
Resumen	330
Introduction	330
Acknowledgments	330
Materials and Methods	331
Species Accounts	335
Plate I	340
Biogeography	364
Literature Cited	373

ABSTRACT

Collections of amphibians and reptiles from the vicinities of San Jacinto and Teniente López in the northern part of Departamento Loreto in Amazonian Peru include 68 species of amphibians and 46 of reptiles. Among five new species are two *Eleutherodactylus*, one *Adelophryne*, one *Phyllomedusa*, and one microhylid not assigned to a recognized genus. *Hyla cabrerai* Cochran and Goin, 1970, and *Osteocephalus planiceps* Cope, 1874, are resurrected from the synonymies of *Osteocephalus buckleyi* and *Osteocephalus taurinus*, respectively. *Hyla albopunctulata* and *Phyllomedusa coelestis* are redescribed. *Hyla albopunctulata*, *Osteocephalus cabrerai*, *Eleutherodactylus quaquaversus*, *Adelophryne adriastola*, and *Lepidoblephanus hoogmoedi* are reported for the first time from Peru, and a notable northern range extension is reported for *Hyla koechlini*. Comparisons of three sites show considerable difference in species composition and reflect patchiness of the rainforest. Comparisons of composition, abundance, diel activity, microhabitat, and masses of anurans and lizards from two study zones also reveals considerable differences. The taxonomic composition of the anurans and lizards at the sites in northern Loreto is more like that at Santa Cecilia, Ecuador, than those at Cocha Cashu and Cuzco Amazónico, Peru.

KEY WORDS: Amphibia, Reptilia, Amazonian Peru, taxonomy, new species, biogeography.

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RESUMEN

Colecciones de anfibios y repiles efectuados en los alrededores del San Jacinto y Teniente López en la parte norte del Departamento de Loreto en la región amazónica del Perú incluye 68 especies de anfibios y 46 especies de reptiles. Entre cinco especies nuevas están dos especies de *Eleutherodactylus*, una *Adelophryne*, una *Phyllomedusa*, y un microhílido no asignado a un género reconocido. *Hyla cabrerai* Cochran y Goin, 1970, y *Osteocephalus planiceps* Cope, 1874, se resucitan de las sinonimias de *Osteocephalus buckleyi* y *Osteocephalus taurinus*, respectivamente. *Hyla albopunctulata* y *Phyllomedusa coelestis* se describen nuevamente. *Hyla albopunctulata*, *Osteocephalus cabrerai*, *Eleutherodactylus quaquaversus*, *Adelophryne adiasola*, y *Lepidoblepharus hoogmoedi* se registran para primera vez del Perú, y se amplía notablemente al norte el Earea de distribución de *Hyla koechlini* hacia al norte. Las comparaciones de la composición, abundancia, actividad diaria, microhábitat, y biomasa de los anuros y los saurios de las dos zonas de estudio también revelan diferencias considerables. La composición taxonómica en anuros y saurios de los localidades del norte de Loreto es más similar a la de Santa Cecilia, Ecuador, que a las de Cocha Cashu y Cuzco Amazónico, Perú.

PALABRAS CLAVES: Amphibia, Reptilia, Región Amazónica del Peru, taxonomía, especies nuevas, biogeografía.

INTRODUCTION

The last two decades have witnessed numerous studies on the herpetofauna of the Amazon Basin. Major faunal studies embrace anurans and lizards near Belém, Brazil (Crump, 1971), the herpetofauna of Santa Cecilia, Ecuador (Duellman, 1978), anurans at Panguana, Peru (Toft and Duellman, 1979; Schlüter, 1984); the reptiles in the Iquitos region, Peru (Dixon and Soini, 1986); the lizards at Cuzco Amazónico, Peru (Duellman, 1987), the herpetofauna at Cocha Cashu, Peru (Rodríguez and Cadle, 1990); the herpetofauna at the INPA Reserves near Manaus, Brazil (Zimmerman and Rodrigues, 1990), lizards at Balbina, Brazil (Martins, 1991); the herpetofauna at Cuzco Amazónico, Peru (Duellman and Salas, 1991); the anurans at Cocha Cashu, Peru (Rodríguez, 1992); snakes from a site in Rondônia, Brazil (Silva, 1993), and lizards of Amazonian Brazil (Avila-Pires, 1995). Comparisons of herpetofaunal communities were provided by Duellman (1989, 1990). Neotropical anuran diversity was summarized by Duellman (1988), and anuran biogeography of cis-Andean tropical lowlands was analyzed by Heyer (1988).

Despite this seemingly intense effort, our knowledge of the Amazonian herpetofauna is far from complete. It is becoming increasingly obvious that the Amazon rainforest is highly heterogeneous (Gentry, 1988) and that environmental diversity is reflected in patterns of diversity and dis-

tribution among the animals inhabiting the rainforest. Consequently, visits to previously unstudied areas invariably result in the documentation of significant range extensions and the discovery of new species. Likewise, previously unknown species commonly are found in areas that have been studied previously. As an example of the rate of discovery, 18% of the 256 species of amphibians in the Amazon Basin have been named since 1980.

This report is based on collections of amphibians and reptiles made as part of a biological survey at two previously unstudied localities in extreme northern Departamento Loreto, Peru. The localities are within an oil concession currently being operated by Occidental Peruana Inc. (formerly Occidental Petroleum Company) in the region disputed by Ecuador and Peru but controlled as a *zona militar* by Peru since 1941. In 1974 the Occidental Petroleum Company of Peru began exploration in a concession (Block-IAB); this operation was expanded and now consists of many camps connected by roads to the major facility at Andoas (Fig. 1). Our purpose herein is to provide: (1) accounts of the 114 species of amphibians and reptiles found at sites in northern Loreto, Peru, (2) compare the samples from these sites, and (3) compare the herpetofauna of this region with those at other regions in the central and upper Amazon Basin.

ACKNOWLEDGMENTS

The field studies in northern Peru were made possible by the generous support of Occidental Peruana Inc. We are greatly indebted to Carlos Delius, President; Joaquin Rodríguez, Vice President for Operations; and especially Clark Hull, Environmental Manager. Work in Block-IAB was facilitated by José Luis Adrianzen, René La Rosa, Robert Palmer, Joseph Pine, Charles Schwab, and Aubry C. Sudduth. Our collections benefited from material found by our coworkers in the field—César Ascorra, Constantino Auca, Richard A. Leschen, Romel Mora de Aguila, Alfonso Miranda, Richard O. Prum, Robert M. Timm, David M. Webb, and Neal Woodman. We are grateful to Robin Foster for botanical data, to Diane M. Debinski and Paul Rich for physical environmental data, and to Gilberto Pezo for installing traps and drift fences and maintaining trails. Field work was supported in part by a grant (DEB

9311799) from the National Science Foundation (W. E. Duellman, Principal Investigator) and the Neotropical Biological Diversity Fund of the Natural History Museum, University of Kansas. Arrangements with Occidental Peruana Inc. and for Peruvian permits were handled by the Asociación de Ecología y Conservación (ECCO); we are grateful to B. Anthony Luscombe, President of ECCO, for his efforts in our behalf. Permits were issued by Ing. Absalón Vásquez Villanueva, Ministerio de Agricultura. For the loan of specimens or provision of working space in their respective institutions, we are grateful to Alice G. C. Grandison (British Museum), Marinus S. Hoogmoed (Rijksmuseum van Natuurlijke Historie), Edmond Malnate (Academy of Natural Sciences of Philadelphia), Roy W. McDiarmid (National Museum of Natural History), and Teresa Cristina Sauer de Avila-Pires (Museu Paraense

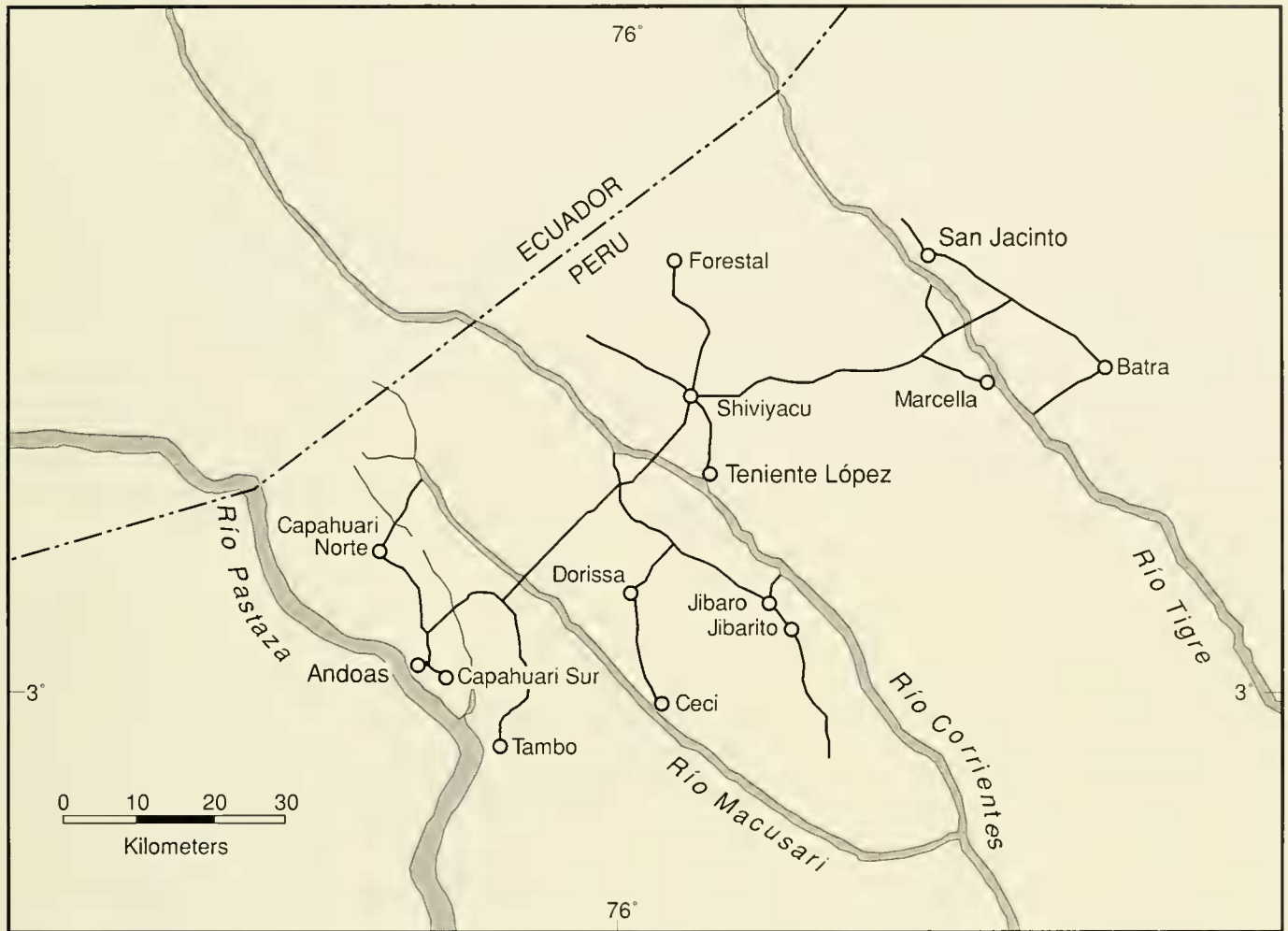


Fig. 1. Map of northern Departamento Loreto, Peru, showing major rivers and localities mentioned in text.

Emilio Goeldi). We thank David A. Kizirian for assistance with the identification of gymnophthalmid lizards, William W. Lamar for permission to include some data recorded by him, Amy Lathrop for faithfully executing drawings of specimens, John E. Simmons for his skillful work in the darkroom, Linda Trueb for aid with the graphics, James Diffendorfer and Erik R. Wild for assistance with some of the statistical analyses, William W. Lamar and John D. Lynch for constructive comments on the manuscript, and Ignacio de la Riva for assistance with the Resumen. All photographs were taken by William E. Duellman; cost of the color plate was funded by the Herpetology Research Fund, Natural History Museum, The University of Kansas.

MATERIALS AND METHODS

A pilot project to assess the biodiversity at sites in Block-IAB in the northern part of Departamento Loreto, Peru, was planned and approved in December 1992. The project was a cooperative effort by the Center of Neotropical Biological Diversity of the Natural History Museum at The University of Kansas, the Asociación de Ecología y Conservación de Lima, Peru, and Occidental Peruana Inc.

In January 1993 study sites were selected by William E. Duell-

man and Martín Timaná, and together with Tomás Luna C. they surveyed the study zones and laid out 25 20 X 20 meter quadrats distributed throughout each study zone so as to incorporate the diversity of habitats. Thus, at San Jacinto quadrats were placed along the border of a black-water swamp and in secondary and primary forest. At Teniente López quadrats were placed along small streams, on slopes, and on ridge tops in primary forest. In April 1993 physical environmental data were collected by Diane M. Debinski and Paul M. Rich; during the same time Tomás Luna C. surveyed elevations of the quadrats. Geographic coordinates were determined by means of a Garmin GPS 75 Personal Navigator™ in July 1993 by William E. Duellman.

The location and description of each of the places from which specimens were obtained are (Figs. 2 and 3):

San Jacinto Camp.— $02^{\circ}18'42.8''S$, $75^{\circ}51'57.9''W$, 180 m (south helipad). Large clearing with grass; many buildings, concrete sidewalks, and dirt roads.

San Jacinto Study Zone.— $02^{\circ}18'44.8''S$, $75^{\circ}51'46.0''W$, 180 m (entrance of trail from road). Partially disturbed rainforest on low rolling terrain with a system of 25 20 X 20 m quadrats in an area extending from the west edge of a blackwater lagoon (175 m elevation) for 280 m to the northeast and 160 m to the northwest and encompassing elevations of 175–190 m.

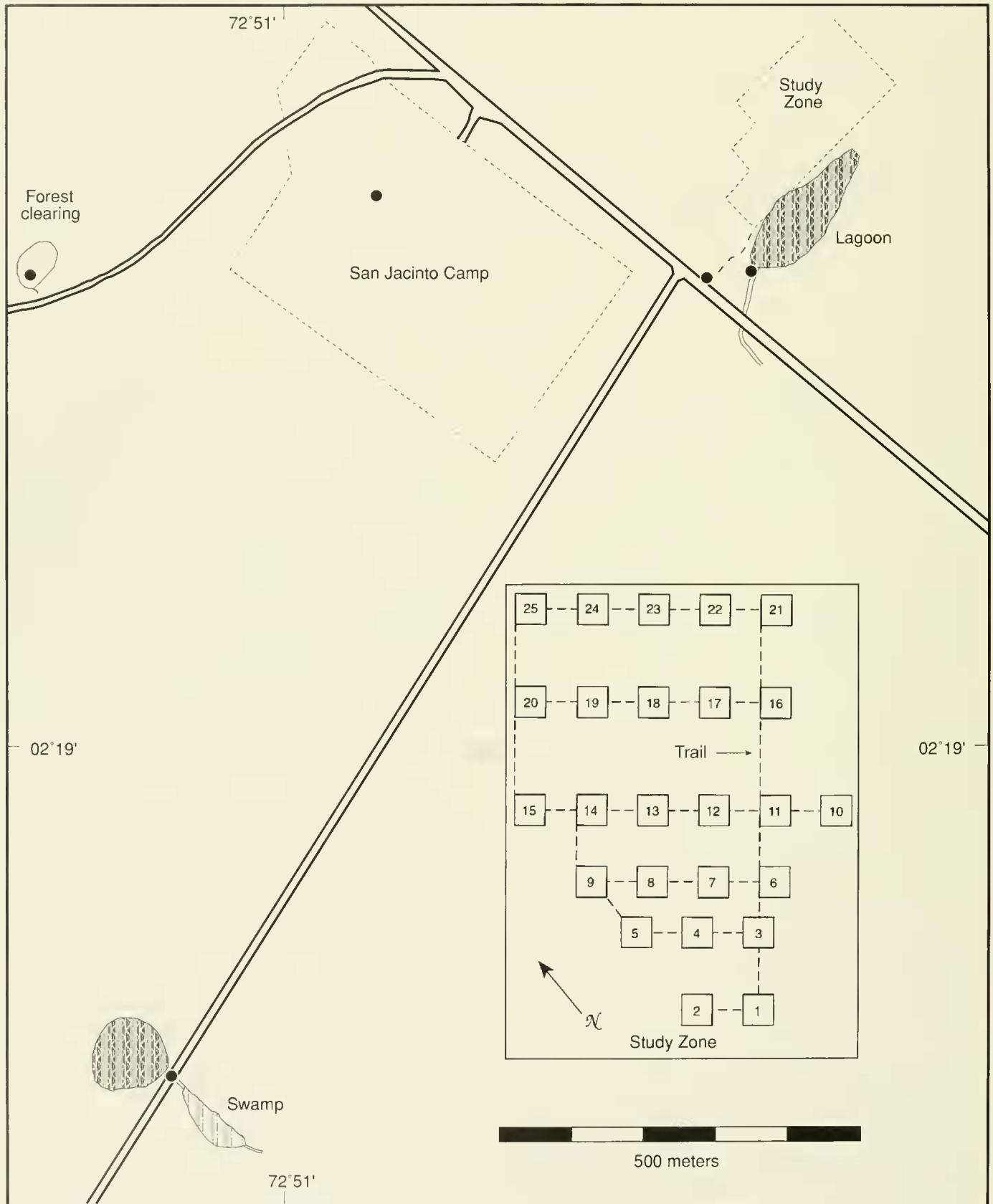


Fig. 2. Map of the San Jacinto area showing roads and sites mentioned in the text. The study zone is shown in detail in the inset. Dots are sites of readings with a geographic positioning device.

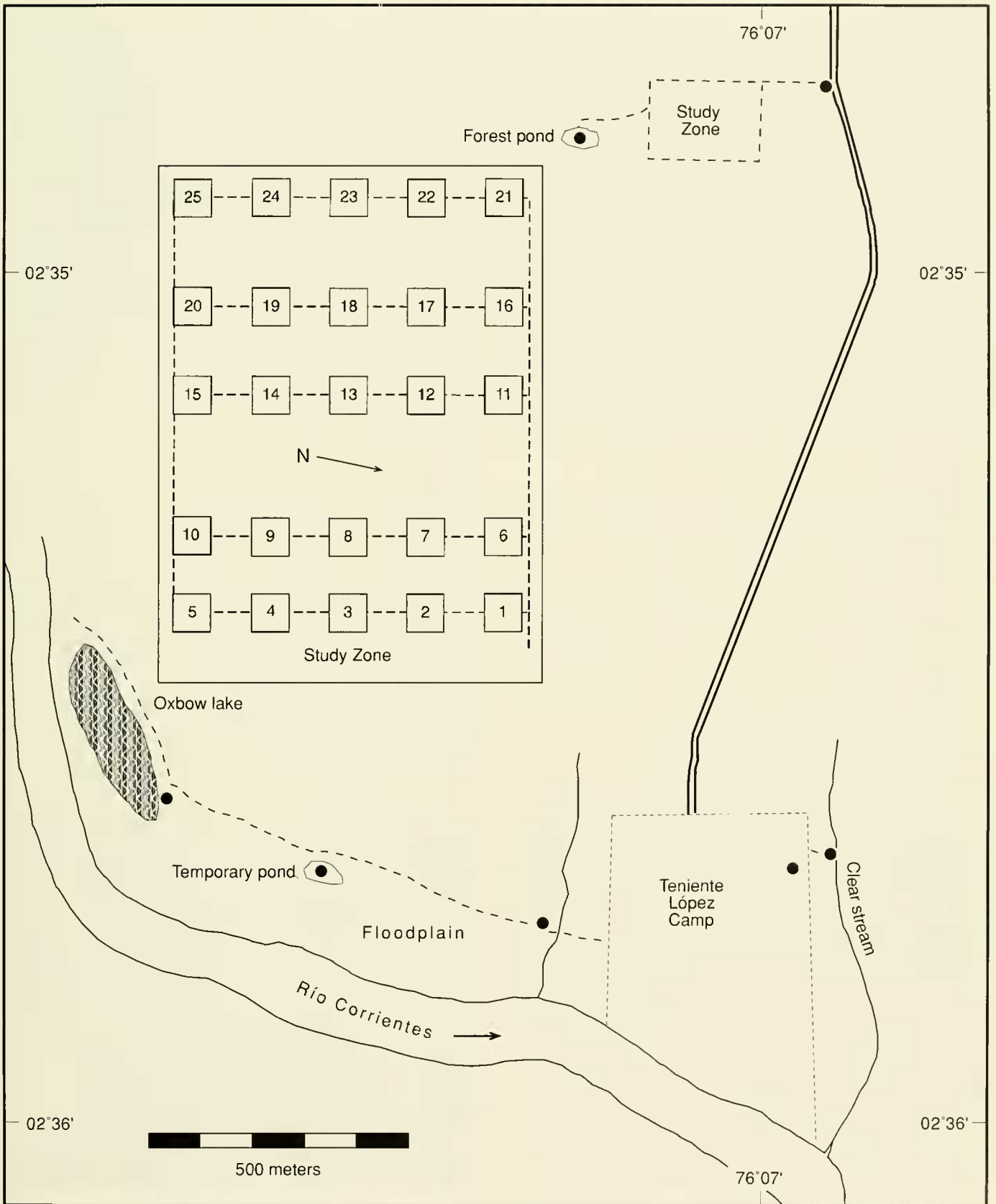


Fig. 3. Map of the Teniente López area showing roads and sites mentioned in the text. The study zone is shown in detail in the inset. Dots are sites of readings with a geographic positioning device.



Fig. 4. Lagoon at San Jacinto. Quadrats 1, 3, and 6 in the study zone are at the border of the lagoon on the left. July 1993.

San Jacinto Lagoon.— $02^{\circ}18'44.2''\text{S}$, $75^{\circ}51'44.8''\text{W}$, 175 m (south edge). A black-water lagoon (approximately 150 X 40 m) to the north of the road at Km 47.1, bordered on the south by marshy clearing and elsewhere by rainforest (Fig. 4).

San Jacinto Swamp.— $02^{\circ}19'11.0''\text{S}$, $75^{\circ}52'03.3''$, 175 m (at culvert). A site about 0.5 km south of the San Jacinto Camp on the road to Well Sites 16, 17, and 20. The road dams a large pond (approximately 80 m diameter) to the west and a grassy swamp to the east; both are surrounded by relatively undisturbed rainforest (Fig. 5).

San Jacinto Forest Clearing.— $02^{\circ}18'45.0''\text{S}$, $75^{\circ}52'08.2''$, 180 m (in center). A newly cleared (May 1993) area within rainforest (approximately 120 X 80 m) to the north of the road west of San Jacinto Camp.

Teniente López Camp.— $02^{\circ}35'40.4''\text{S}$, $76^{\circ}06'56.8''\text{W}$, 200 m (parking lot in front of staff dining hall). Large, cleared ridge top



Fig. 6. Oxbow lake on floodplain of the Río Corrientes west of the Teniente López Camp. July 1993.



Fig. 5. Swamp to the east of the road just south of the San Jacinto Camp. July 1993.

with many buildings, grass, and dirt roads.

Teniente López Stream.— $02^{\circ}35'40.0''\text{S}$, $76^{\circ}06'55.0''\text{W}$, 190 m (pump house). A swift, clear tributary of the Río Corrientes, 3–5 m wide with sandy bottom completely shaded by partially disturbed rainforest.

Teniente López Floodplain.— $02^{\circ}35'44.8''\text{S}$, $76^{\circ}07'15.0''\text{W}$, 185 m (east edge). Disturbed rainforest on floodplain of Río Corrientes west of the Teniente López Camp.

Teniente López Temporary Pond.— $02^{\circ}35'40.8''\text{S}$, $76^{\circ}07'30.3''$, 185 m (middle). An irregular water-filled depression (approximately 70 X 20 m) in disturbed rainforest on the floodplain west of Teniente López.

Teniente López Oxbow Lake.— $02^{\circ}35'38.3''\text{S}$, $76^{\circ}07'41.7''\text{W}$, 185 m (southeast shore). An oxbow of the Río Corrientes in the floodplain west of the Teniente López Camp (Fig. 6).

1.5 km N Teniente López Forest Pond.— $02^{\circ}34'52.5''\text{S}$,



Fig. 7. Forest pond to the west of the study zone 1.5 km N Teniente López. July 1993.

76°07'12.6"W, 310 m (middle). A permanent or semipermanent pond supporting *Heliconia* in a depression in rainforest to the west of the study zone (Fig. 7).

1.5 km N Teniente López Study Zone.—02°18'43.2"S, 75°51'58.1"W, 333 m (trail at road 1.5 km N Teniente López). Study zone of a system of 25 quadrats 20 X 20 m extends west from 118 to 365 m from the road along a trail at a bearing of 288° and south for a distance of 180 m. Rolling terrain (310–340 m) with steep slopes and small, sandy bottomed streams in primary rainforest.

Throughout the text, San Jacinto is abbreviated SJ, Teniente López TL, and 1.5 km north of Teniente López NTL.

One soil sample was collected at the center point of each quadrat in both study zones using an auger 8.75 cm in diameter; the auger was turned into the soil to a depth of 15 cm, and samples were sealed in plastic bags. Samples were analyzed at Soil, Plant, and Water Testing Laboratory, Colorado State University, Ft. Collins, Colorado. Soil samples were analyzed for calcium, magnesium, sodium, potassium, percent organic matter, Total Olsen phosphate, total organic carbon, nitrogen, carbon/nitrogen ratio, pH, chlorine, and cation exchange capacity. Hydrometer readings were used to estimate the percentage of sand, silt, and clay. Texture was noted as sandy clay loam, clay loam, sandy loam, clay, or combination thereof.

All trees ≥ 10 cm in diameter at breast height (DBH) in the 25 quadrats in each study site were measured and tagged with a unique number. All such trees were identified to species in the field or, if identification was not possible in the field, samples were collected for future identification.

Sampling of amphibians and reptiles was done by personnel walking trails in the study zones and in other areas both by day and night. Also five arrays of drift fences with pitfall traps were established in each quadrat system; each array consisted of 20 meters of aluminum fencing and five pitfall traps (Fig. 8). These traps were checked shortly after first light each morning, again shortly before dark, and usually again at night. In this way diel activity was ascertained. All individuals were recorded with respect to quadrat number and date; exclusive of specimens found in pitfall traps, all individuals observed also were recorded with respect to time, height above ground, and activity. Usually within a few hours after capture, specimens were weighed using Pesola scales; after specimens were anesthetized, tissues (usually striated muscle and liver) were preserved in liquid nitrogen. Specimens were then preserved in 10% formalin and subsequently transferred to 70% ethanol.

Unless noted otherwise in specific accounts, the taxonomy used herein follows Duellman (1993) for anurans and Peters and Donoso-Barros (1970) and Peters and Orejas-Miranda (1970) for squamates, except that for iguanians we follow Frost and Etheridge (1989) and Frost (1992), and for pitvipers Campbell and Lamar (1989). In the accounts of the species, all measurements are in mm and masses (weights) in grams. Measurements of anurans follow Duellman (1970); snout-vent length is abbreviated SVL. Measurements of squamates are given as SVL + tail length. Webbing formulae for anurans are based on Savage and Heyer (1967) as modified by Myers and Duellman (1982). Stomachs of all snakes were examined for the presence of prey items. The specimens were divided between the Natural History Museum at The University of Kansas (KU) and the Museo de Historia Natural, Universidad Ricardo Palma, Lima, Peru. Catalogue numbers have yet to be assigned to the latter specimens, so they are referred to by URP-WED field numbers. Other museum codes are: ANSP Academy of Natural Sciences, Philadelphia; BM Natural History Museum, London; MLS, Museo La Salle, Santa Fe de Bogotá, Colombia; MPEG Museu Paraense Emílio Goeldi, Belém, Brazil; RMNH Rijksmuseum



Fig. 8. Aluminum drift fences and pitfall traps in Quadrat No. 6 in the study zone at San Jacinto. July 1993.

van Natuurlijke Historie, Leiden, Netherlands; USNM National Museum of Natural History, Washington; WCAB Werner C. A. Bokermann, São Paulo, Brazil.

SPECIES ACCOUNTS

Families, genera, and species are arranged alphabetically within orders.

BUFONIDAE

Bufo marinus (Linnaeus)

At SJ, five juveniles and subadults were found in the camp clearing, and one gravid female having a SVL of 144.0 and a mass of 240 was in a pitfall trap in the forest about 5 m from the edge of the lagoon and about 50 m from the edge of the forest. A subadult male having a SVL of 80.0 and a mass of 44.0 was on the riverbank at night at TL.

Bufo typhonius Complex

The systematic status of the forest-dwelling toads generally referred to *Bufo typhonius* is under study by Marinus S. Hoogmoed, who recognizes at least seven sympatric species in the complex in eastern Ecuador and northern Peru (Hoogmoed, 1986). Three species were identified among the material collected at the study sites in northern Loreto, Peru. All three have the first and second fingers equal in length, lateral fringes on the fingers and toes, and the digital tips terminating in distinct, round, pads. Assignment of names to these species awaits the completion of Hoogmoed's studies. In the meantime, each taxon is discussed herein under alphabetical designations. The characters used to define each species are given in the same numerical order in each account.

Species A

This species can be defined as follows ($n = 9 \sigma\sigma$, 9♀♀ , 20 juveniles): (1) SVL $\sigma\sigma$ 45.9–67.4 ($\bar{x} = 57.7$), ♀♀ 48.0–76.0 ($\bar{x} = 59.6$); (2) mass $\sigma\sigma$ 9.0–26.3 ($\bar{x} = 15.0$), ♀♀ 13.5–37.5 ($\bar{x} = 18.6$); (3) snout pointed in dorsal view, greatly protruding beyond margin of lip, rounded above, and curved posteroventrally in profile; (4) nostrils protuberant dorsolaterally at point above anterior margin of lower jaw; (5) canthal, supraorbital, and supratympanic crests continuous; supratympanic crest greatly hypertrophied and expanded dorsolaterally in females; (6) tympanum round, distinct, 55–60% diameter of eye; (7) bony protrusion at angle of jaws small in males, large in females; (8) neural crests of vertebrae barely protruding in males, greatly protruding in females; (9) parotoid glands triangular, protruding laterally, incorporated into lateral row of tubercles; (10) lateral row of tubercles rounded in males and long, tubercles conical in females; (11) skin on dorsum smooth in males, tubercular in females; (12) skin on dorsal surfaces of limbs smooth in males, spinous in females; (13) palmar tubercle large, ovoid, 3 times size of subtriangular thenar tubercle; (14) inner metatarsal tubercle elliptical, twice size of ovoid outer metatarsal tubercle; (15) modal webbing on foot I 1—2 II 1—3 III 1 $\frac{1}{2}$ —3 $\frac{1}{2}$ IV 3 $\frac{1}{2}$ —1 $\frac{1}{2}$ V; (16) supernumerary tubercles large, round, nearly size of subarticular tubercles; (17) vocal slits and nuptial excrescences present in males.

In life, the dorsum varies from reddish brown to yellowish tan with or without markings consisting of small dark brown to black spots, large black mark in scapular region, or black snout (Fig. 9). The flanks are colored like, or are darker than, the dorsum. The lateral row of tubercles (and protruding neural spines in females) are pale tan to yellowish orange. The venter is orange-tan with varying amounts of dark gray mottling or gray with cream spots posteriorly.

This species was found at SJ, TL, and NTL. Most individuals were either active on the forest floor by day or found in pitfall traps by day; six adults and one juvenile were sleeping on vegetation 0.2–0.5 m above ground at night. Twenty juveniles have SVLs of 16.0–30.0 and masses of 0.1–1.6.

Species B

This species can be defined as follows ($n = 2 \sigma\sigma$): (1) SVL $\sigma\sigma$ 52.2–54.9 ($\bar{x} = 53.6$); (2) mass $\sigma\sigma$ 8.0–9.6 ($\bar{x} = 8.8$); (3) snout pointed in dorsal view, greatly protruding beyond margin of lip, pointed above, and inclined posteroventrally in profile; (4) nostrils protuberant posterodorsally at point anterior to anterior margin of lower jaw; (5) canthal crest not elevated; supraorbital and supratympanic crests continuous; supratympanic crest not hypertrophied and expanded; (6) tympanum round, distinct, 55–60% diameter of eye; (7) bony protrusion at angle of jaws small; (8) neural crests of vertebrae barely protruding; (9) parotoid glands narrowly elliptical, not protruding laterally, incorporated into lateral row of tubercles; (10) lateral row of long, conical tubercles present; (11) skin on dorsum tubercular; (12) skin on dorsal surfaces of limbs spinous; (13) palmar tubercle large, round, four times size of subconical thenar tubercle; (14) inner metatarsal tubercle ovoid, twice size of round outer metatarsal tubercle; (15) modal webbing on foot I 1—2 II 1—3 III 2—3 IV 3—2 V; (16) supernumerary tubercles moderate, subconical, about one half size of subarticular tubercles; (17) vocal slits present and nuptial excrescences absent in males.

In life, the dorsum is dark brown with diffuse slightly paler blotches and cream lateral tubercles (Fig. 9). The venter is dull cream with a gray suffusion on the throat and chest.

One individual was on the forest floor by day at SJ, and one was sleeping at night on a vine 2 m above the edge of a stream at night at TL.

Species C

This species can be defined as follows ($n = 6 \sigma\sigma$, 10♀♀ , 11 juveniles): (1) SVL $\sigma\sigma$ 40.6–53.7 ($\bar{x} = 46.7$), ♀♀ 46.0–56.7 ($\bar{x} = 51.3$); (2) mass $\sigma\sigma$ 3.6–13.0 ($\bar{x} = 7.8$), ♀♀ 6.0–14.0 ($\bar{x} = 10.3$); (3) snout pointed in dorsal view, greatly protruding beyond margin of lip, pointed above, and inclined posteroventrally in profile; (4) nostrils protuberant posterodorsally at point anterior to anterior margin of lower jaw; (5) canthal crest not elevated; supraorbital and supratympanic crests continuous; supratympanic crest hypertrophied and slightly flared laterally in both sexes; (6) tympanum round, indistinct posteriorly, 75–80% diameter of eye; (7) bony protrusion at angle of jaws absent; (8) neural crests of vertebrae not protruding; (9) parotoid glands narrowly elliptical, not protruding laterally, incorporated into lateral row of tubercles; (10) lateral row of conical tubercles present; (11) skin on dorsum tubercular; (12) skin on dorsal surfaces of limbs spinous; (13) palmar tubercle large, ovoid, three times size of elliptical thenar tubercle; (14) inner metatarsal tubercle ovoid, half again size of ovoid outer metatarsal tubercle; (15) modal webbing on foot I 1—2 II 1—3 III 1—3 $\frac{1}{2}$ IV 3 $\frac{1}{2}$ —1 V; (16) supernumerary tubercles large, subconical, nearly size of subarticular tubercles; vocal slits and nuptial excrescences absent in males.

The dorsum varies from grayish tan to reddish tan with darker brown markings, usually in the form of a broad middorsal mark with irregular edges; other individuals have only a few dark brown spots on the dorsum (Fig. 9). A middorsal cream stripe is present in some specimens. The spines in the lateral row are tan. The venter varies from gray with cream spots to orange-tan with gray mottling.

This species was found at SJ, TL, and NTL. One juvenile and 11 adults were sleeping on vegetation 0.2–1.0 m above ground at night; the others were on the forest floor or in pitfall traps by day. Two recently metamorphosed young from TL have SVLs of 5.8 and 6.7, and masses of < 0.1.

Dendrophryniscus minutus (Melin)

Of nine adults and three juveniles, all were found amid leaf litter on the ground by day in the floodplain forest at TL, except one male was on the shore of the oxbow lake at night. Three males have SVLs of 15.3–17.7 ($\bar{x} = 16.8$) and masses of 0.4–0.5 ($\bar{x} = 0.43$); six gravid females have SVLs of 17.3–19.4 ($\bar{x} = 18.4$), and masses of 0.3–0.7 ($\bar{x} = 0.45$). Three juveniles have SVLs of 7.8–10.2 ($\bar{x} = 8.8$) and masses of < 0.1. The venter is reddish purple; all except one male have orange spots on the belly.

DENDROBATIDAE

Colostethus trilineatus (Boulenger)

Seven individuals were active in thick leaf litter in flood-

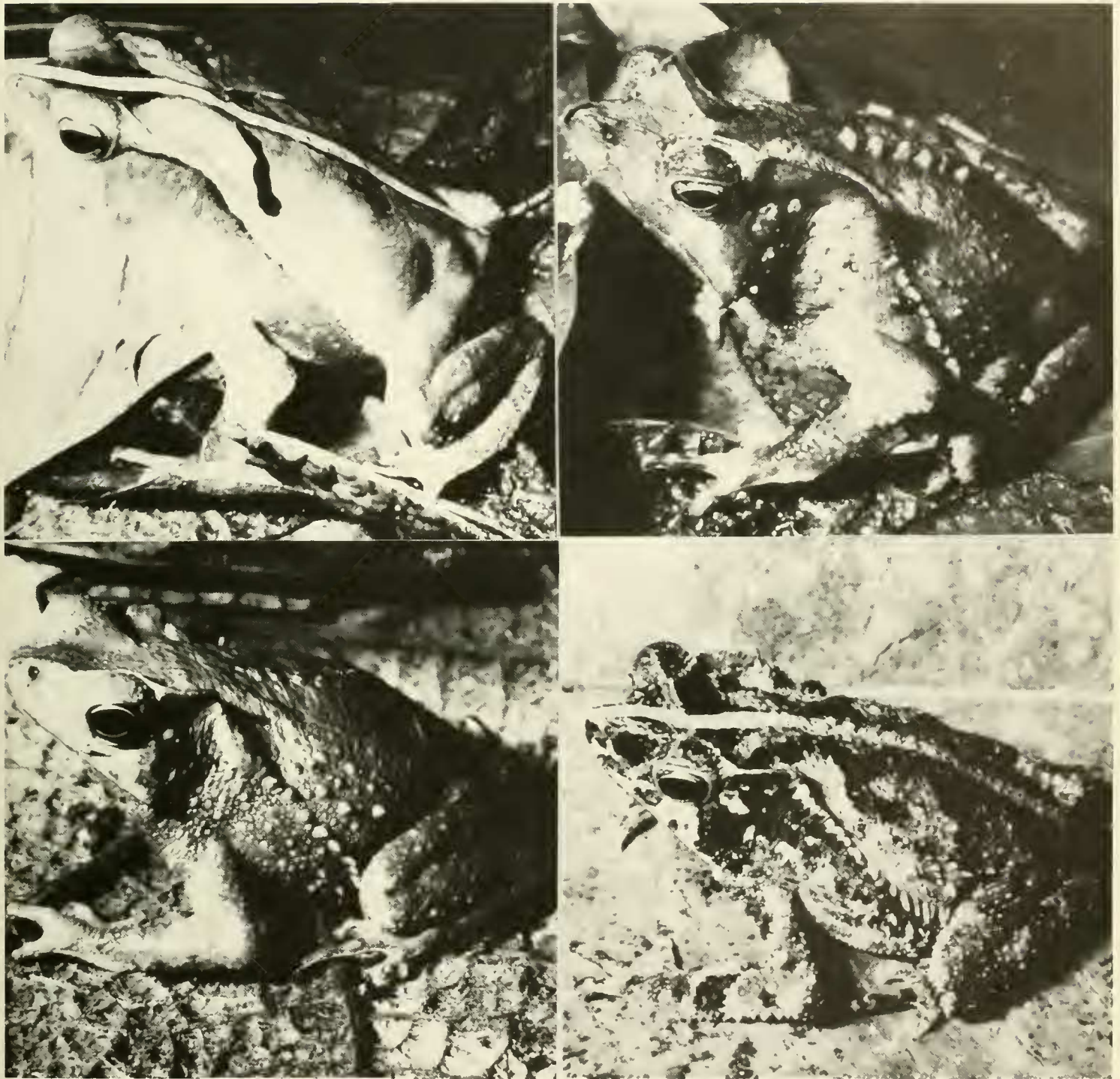


Fig. 9. *Bufo typhonius* complex. Top left—Species A, KU 221794, adult male, 53.5 mm SVL. Top right—Species A, KU 221793, adult female, 58.5 mm SVL. Bottom left—Species B, KU 221810, adult male, 52.2 mm SVL. Bottom right—Species C, KU 222326, adult female, 55.0 mm SVL.

plain forest at TL on 22 and 23 July. One male has a SVL of 13.9 and a mass of 0.15, and three females have SVLs of 15.8–16.1 (\bar{x} = 15.9) and masses of 0.2–0.3 (\bar{x} = 0.25); two juveniles have SVLs of 10.5 and 11.7 and masses of 0.1 each. In life, the dorsum is brown with a broad tan dorsolateral stripe, below which the flanks are black; the labial and ventrolateral stripes are white; the throat and belly are pale yellow. The undersides of the hind limbs are pale gray, and there is a pinkish tan diagonal mark on the proximal posteroventral surfaces of each thigh. The iris is deep bronze heavily flecked with black.

These specimens are tentatively assigned to this species, which was recognized as distinct from *C. marchesianus* (Melin) by Morales (1994). Upon examining the holotype of *C. trilineatus* (BM 1947.2.14.20), Morales (1994:101) observed "...la presencia de una línea ventrolateral, una línea vertebral fina, una línea labial, una garganta oscura y un tercer dedo manual del macho dilatado." Morales (1994) noted that *C. marchesianus* lacks a vertebral line and males do not have a dark throat; these are the only characters that he gave for distinguishing the two species, neither of which he compared with his new species, *C. juanii*, from Meta, Colombia. However, in the diagnosis of *C. juanii*, it is mentioned that a dorsolateral line is absent, and males do not have a dilated third finger. Among the 42 specimens of *C. trilineatus* that Morales listed from Amazonian Peru are KU 205270–82 and 207547–49 from Cuzco Amazónico, Departamento Madre de Dios, Peru. Assuming those specimens to represent *C. trilineatus*, we prepared a full diagnosis with number characters following the format of Duellman and Simmons (1988).

Diagnosis.—A small species of *Colostethus* characterized by (1) small size, SVL in males 15.1–17.2 (\bar{x} = 16.0, n = 6), in females 15.6–18.5 (\bar{x} = 16.8, n = 10); (2) disc on third finger slightly wider than diameter of finger; (3) first finger much longer than second; (4) fringe absent on second finger; (5) disc on fourth toe much wider than diameter of toe; (7) outer tarsal fold absent; (8) toes unwebbed; (9) dorsolateral stripe present; (10) oblique lateral stripe short, diffuse, and indistinct (n = 13) or absent (n = 3); (11) ventrolateral stripe present, continuous with labial stripe; (12) dark markings absent on chest; (13) dark markings absent on belly; (14) throat gray in males, cream in females; (15) third finger of males not dilated.

It is evident that these specimens that were assigned to *C. trilineatus* by Morales (1994) do not agree in all respects with the characters that he listed for the holotype from Yurimaguas, Peru. Only seven of the 16 specimens have a narrow, pale vertebral line, and none of the males exhibits a swollen third finger. Likewise, the presence of an oblique lateral stripe is variable.

The specimens from TL closely resemble the specimens from Cuzco Amazónico. A pale vertebral line is diffuse in one individual and absent in the others. The oblique lateral stripe is short and diffuse in three individuals and longer and distinct in three others. The only male is a subadult, so throat color and condition of the third finger cannot be determined.

Dendrobates ventrimaculatus Shreve

This small, diurnal species was found on the forest floor at the SJ and NTL study zones and on the floodplain at TL. One female with small ovarian eggs has a SVL of 15.7 and a mass of 0.2; four males have SVLs of 13.0–15.5 (\bar{x} = 14.5) and masses of 0.1–0.2 (\bar{x} = 0.18). All specimens have a distinct inner metatarsal tubercle. In life, the throat is black with a pale spot; the belly and ventral surfaces of the limbs are blue with large black spots, and the other surfaces of the limbs are black with blue reticulations. The dorsal stripes and spot on the chin are pale golden yellow in the female and bright orange in males. The posterior extent of the middorsal stripe is variable—to the scapular region in one, to the sacrum in two, and nearly to the posterior end of the body in two. In one of the specimens in which the stripe extends to the sacrum, the dorsum postsacrally has fine blue reticulations; in the other specimens reticulations are absent on the dorsum of the body.

Dendrobates ventrimaculatus has only recently been resurrected from the synonymy of *D. quinquevittatus* Steindachner and recognized as a possible complex of species (Caldwell and Myers, 1990). The present specimens agree with those described and illustrated (as *D. quinquevittatus*) by Meede (1980) from Panguana, Peru, and the four males agree with the color photograph of an individual from Ecuador (Löters, 1988). Furthermore, they agree with a specimen (KU 220870) from the junction of the Río Yanamono and Río Amazonas, Departamento Loreto, Peru, in color pattern and in having orange stripes on the dorsum. However, they differ from specimens (reported as *D. quinquevittatus*) from Lago Agrió, Ecuador, which have yellow reticulations on the limbs (Duellman, 1978).

Epipedobates femoralis (Boulenger)

One adult male having a SVL of 27.3 and a mass of 1.5 was on the forest floor by day in the study zone at SJ. Four juveniles having SVLs of 13.5–18.2 (\bar{x} = 14.9) and masses of 0.1–0.2 (\bar{x} = 0.17) and one adult male having a SVL of 29.9 and a mass of 2.4 were on the forest floor by day in the study zone at NTL. The latter, found on 23 July, was carrying eight tadpoles in Stage 28 (Gosner, 1960). The tadpoles have body lengths of 4.0 mm and total lengths of 11.5 mm; the second lower and third lower tooth rows are partially developed, whereas the other rows are well developed. The body is black, and the tail creamy tan with small brown spots.

Epipedobates hahneli (Boulenger)

One juvenile male having a SVL of 19.5 and a mass of 0.5 was sleeping on a leaf 1 m above the ground at night in the study zone at SJ. We follow Haddad and Martins (1994) in recognizing this species as distinct from *Epipedobates pictus*.

Epipedobates zaparo (Silverstone)

In the study zones at SJ and NTL, 12 individuals were on

the forest floor and in pitfall traps by day and six were sleeping on low vegetation (0.1–0.7 m) at night. Six males have SVLs of 20.7–22.3 (\bar{x} = 21.4) and masses of 0.6–0.9 (\bar{x} = 0.7); ten females have SVLs of 23.3–27.1 (\bar{x} = 25.4) and masses of 0.7–1.2 (\bar{x} = 1.08). In life, the dorsum is dark red, and the venter is blue and black.

These specimens represent the second and third recorded localities of the species in Peru and the first localities outside the Río Pastaza drainage. Henle (1992) reported it from Capahuari Sur in the Río Pastaza drainage, the same drainage as all Ecuadorian localities for the species (Silverstone, 1976). Capahuari Sur is approximately 40 km SSW of Teniente López and 80 km SW of San Jacinto. Schulte's (1987) record of *E. zaparo* from Departamento San Martín, Peru, was based on specimens subsequently named *Epipedobates cainarachi* (Schulte, 1989) and *Epipedobates ardens* (Jungfer, 1989).

HYLIDAE

Hyla albopunctulata Boulenger

One male having a mass of 1.3 was on the top panel of a mist net (2 m above the ground) on the night of 1 July in the study zone at SJ. Comparison of this specimen with Boulenger's (1882) description and detailed notes on, and photographs of, the type series indicate that the present specimen (KU 221849) represents the rediscovery of this species.

The syntypes are BM 80.12.5.159–162 from "Ecuador" and 80.12.5.230 from "Sarayacu"; all were collected by Buckley. When the syntypes were examined on 16 June 1969, all were in the same jar; BM 80.12.5.159 and 230 had tags attached; the other three specimens were untagged. All of the specimens were soft and somewhat faded. Three males (BM 80.12.5.159, 230, and an untagged specimen) having many small white spots on the dorsum have SVLs of 32.2, 35.6, and 31.0, respectively. Because this species has not been identified with populations in the Amazon Basin, a re-description is provided.

Description.— n = 1 male. Body moderately slender, not as wide as head; snout long, rounded in dorsal view, slightly inclined posteroventrally in profile; canthus rostralis curved, rounded in section; loreal region barely concave; lips thin, moderately flared anterior to orbits; top of head flat; internarial region depressed; nostrils protuberant, directed dorsolaterally at level of anterior margin of lower jaw; eye directed anterolaterally (35° to longitudinal axis); supratympanic fold diffuse, obscuring upper one third of tympanum; tympanic annulus weak; tympanum directed dorso-laterally, separated from orbit by distance 1.5X tympanum.

Forearm moderately robust with ulnar keel continuous with narrow fringe on outer edge of Finger IV; fingers long with round terminal discs; diameter of disc on third finger equal to three fourths diameter of tympanum; relative lengths of fingers I < II < IV < III; fingers webbed basally and bearing narrow lateral fringes; webbing formula for fingers II 2⁺—3 III 3—2 $\frac{1}{2}$ IV; subarticular tubercles moderately large, round, elevated; distal tubercle on Finger IV bifid; supernumerary tubercles absent; palmar tubercle small, round; thenar tubercle large, rectangular; nuptial excrescences absent. Hind limb slender; calcar and heel tubercles absent; inner tarsal fold thin, extending full length of tarsus; outer metatarsal tuber-

cle absent; inner metatarsal tubercle ovoid, visible from above; toes long, bearing discs slightly smaller than those on fingers; relative lengths of toes I < II < III < V < IV; toes about three-fifths webbed; webbing formula I 2⁺—2⁺ II 1—2+ III 1—3⁻ IV 2⁻—1 V; subarticular tubercles large, round, elevated; supernumerary tubercles absent.

Skin on dorsum smooth; skin on belly and ventral surfaces of thighs granular; other surfaces smooth; cloacal opening directed posteroventrally at midlevel of thighs; cloacal sheath short; cloacal folds and tubercles absent. Dentigerous processes of vomers long, narrowly separated medially, inclined posterolaterally between posterior margins of choanae, each bearing nine teeth. Choanae large, elliptical; tongue broadly cordiform, shallowly notched posteriorly, barely free behind. Vocal slit elongate from midlateral base of tongue to angle of jaw; vocal sac single, median, subgular.

Color in preservative: Dorsal surfaces of head, body, and limbs purplish brown (under 10X magnification cream with dense chromatophores on head and body and scattered chromatophores on limbs); discs on digits, margin of upper lip, venter, and hidden surfaces of limbs pale creamy white.

Color in life: At night, pale purple; by day, pale dull green changing to dull tan on dorsum; pale purple on venter and hidden surfaces of limbs; peritoneum white; iris silvery bronze (Pl. 1).

Measurements: SVL 31.6, tibia length 15.8, foot length 12.1, head length 11.8, head width 11.0, interorbital distance 3.0, upper eyelid 2.4, internarial distance 1.9, eye-nostril 3.7, eye 2.8, tympanum 1.5.

Remarks.—The present specimen is the first record of the species from Peru; the only other definite localities are Sarayacu, Provincia Pastaza (BM 80.12.5.159–162), and San Pablo Kantessya, Provincia Napo (KU 221637), Ecuador. The latter specimen is an adult female having a SVL of 30.2 mm. The apparent rarity of this species having a distribution encompassing about 300 km in latitude in the upper Amazon Basin may indicate that it is an inhabitant of the canopy and perhaps breeds in bromeliads. The only reference, other than in checklists, to this species is by Cochran and Goin (1970). As pointed out by Myers and Duellman (1982), Cochran and Goin (1970) erroneously placed *Hyla palmeri* Boulenger 1908, in the synonymy of *Hyla albopunctulata* and based their description of the latter species on a specimen of the former. Frost (1985) commented that *Hyla albopunctulata* questionably is in the *Hyla bogotensis* group. After examining the present specimen, this suggestion lacks merit; the relationships of *H. albopunctulata* are unclear, but it does not seem to be associated with the *Hyla bogotensis* group, adult males of which have a mental gland and proportionately more robust bodies and limbs. Only one of the specimens in the type series of *H. albopunctulata* has small white spots on the dorsum. Boulenger's (1882) description does not agree in all respects with his illustration (Plate XXIV, Fig. 4) or with the specimen (unlabelled, but with white spots) that he described and illustrated. He stated that the head is wider than long; my measurements of the specimens indicate the opposite. Boulenger stated that the outer fingers were one-half webbed and the toes fully webbed; his illustration shows the fingers to be no more than one-third webbed and the toes no more than two-

PLATE 1



Hyla albopunctulata, KU 221849, male, 31.6 mm SVL.



Phyllomedusa hulli, URP-WED 60198, male, 37.1 mm SVL.



Osteocephalus buckleyi, KU 221926, female, 50.0 mm SVL.



Osteocephalus cabrerai, KU 221927, female, 41.0 mm SVL.



Eleutherodactylus delius, URP-WED 59957, female, 30.9 mm SVL.



Eleutherodactylus luscombei, KU 222002, female, 26.1 mm SVL.



Adelophryne tridactyla, KU 221992, female, 11.5 mm SVL.



Microhylid, KU 222108, female, 17.8 mm SVL.

thirds webbed; the degree of webbing was confirmed to be correct in the illustration.

Hyla boans (Linnaeus)

A gravid female having a SVL of 106.3 and a mass of 67.0 was on the ground in the camp clearing at SJ at 0615 h on 3 July. On the night of 18 July at TL several males were calling from boulders in, and trees along, a clear stream with sandy banks. The one male collected has a SVL of 113.5 and a mass of 31.0 g.

Hyla brevifrons Duellman and Crump

Three males were calling from emergent vegetation 1.0–1.5 m above the surface of the temporary pond at TL on the night of 22 July. These specimens have SVLs of 16.0–16.3 (\bar{x} = 16.1) and masses of 0.2–0.3 (\bar{x} = 0.27); they agree in color and external morphology with the description of Duellman and Crump (1974).

Hyla calcarata Troschel

With the exception of a single male having a SVL of 34.7 and a mass of 2.2 on a branch of a bush 0.5 m above the edge of the oxbow lake at TL on 24 July, all individuals were found at the edge of a black-water lagoon at SJ on the nights of 30 June–5 July. Individuals were perched perpendicularly on vines or branches of bushes 0.1–2.0 m above the edge of the lagoon. No calls were heard. Of the specimens from SJ, two gravid females have SVLs of 49.6 and 54.3 and masses of 4.3 and 4.8; 17 males have SVLs of 35.4–40.5 (\bar{x} = 38.4) and masses of 1.9–2.8 (\bar{x} = 2.38).

Hyla fasciata Günther

One male was perched on a vine 0.2 m above a small stream in the study zone at NTL on the night of 23 July; 11 males were on reeds and bushes in the swamp at SJ on the nights of 7–11 July. These 12 males have SVLs of 30.1–33.5 (\bar{x} = 31.4) and masses of 1.2–2.0 (\bar{x} = 1.36).

Hyla geographica Spix

With the exception of one nongravid female having a SVL of 55.5 and a mass of 6.2 on a limb of a tree 3 m above the ground in primary forest at NTL on the night of 16 July and a gravid female on the limb of a bush 1.5 m above the stream at TL on the night of 22 July, all individuals were on low vegetation (0.5–0.7 m) at the edge of permanent water at night—one male in the swamp at SJ on 7 July and one female and seven males at the oxbow lake at TL on 24 and 25 July. Eight males have SVLs of 40.9–51.0 (\bar{x} = 44.8) and masses of 2.3–5.5 (\bar{x} = 3.68); two gravid females have SVLs of 65.2 and 68.7 and masses of 13.5 and 19.5.

Color notes on a nongravid female (KU 221870): Dorsum tan with dark brown and pale cream marks; flanks and hidden surfaces of thighs bluish gray with black vertical marks;

venter deep yellow with brown spots on belly; iris orange-brown; palpebrum reticulate. In contrast, a male (KU 221869) had the belly and undersides of the limbs orange, and the flanks orange with brown bars. All but three individuals have pale spots on the dorsum. One female (KU 221871) has four large and two small spots on the dorsum and white heels; two females and five males have 1–8 small white spots on the dorsum; three of these have white heels, and in one specimen the white is restricted to the calcars. The coloration and structure of these specimens agrees with the detailed descriptions given by Duellman (1973a, 1978).

A large school of tadpoles was observed in the oxbow lake at TL on 23 July. A sample of 25 individuals agrees with the description provided by Hero (1990). The sample contains specimens in Stages 31–33 (Gosner, 1960) having body lengths of 13.8–16.5 (\bar{x} = 14.9) and total lengths of 34.9–41.5 (\bar{x} = 37.8). These tadpoles are uniform black and have a labial tooth row formula of 3/5; the first upper row is just inside the fringing papillae, is made up of small teeth, and is interrupted medially, as is the third upper row. The first lower row is shorter than the others, and the fifth row is incomplete and made up of small teeth.

Hyla granosa Boulenger

Males were calling from leaves 3–10 cm above the water at the edge of the lagoon and in the swamp at SJ nearly every night between 30 May and 11 July. Four males have SVLs of 33.6–36.1 (\bar{x} = 34.9) and masses of 2.0–2.5 (\bar{x} = 2.18). A metamorphosing young having a SVL of 12.0 was on an emergent reed in the open pond on 9 July. In life, the dorsum and venter of the young individual were pale green; faint reddish brown canthal and postorbital stripes were evident. The digits were pale yellow, and the iris was creamy yellow.

Hyla koechlini Duellman and Trueb

Males were calling from low vegetation (< 1.0 m) at the edge of a pond in primary forest at NTL on the nights of 20 and 24 July. Another male was on the leaf of a tree 2 m above the ground near the same pond on the night of 22 July, and a gravid female was on low vegetation at the edge of the pond on 20 July. The gravid female has a SVL of 25.4 and a mass of 1.3; eight males have SVLs of 19.5–22.0 (\bar{x} = 20.8) and masses of 0.4–0.6 (\bar{x} = 0.53). The female has black thighs and anterior and posterior surfaces of the thighs, whereas the flanks in the males are brown. One male has two pale spots on the anterior surfaces of the thighs, and two others each have one spot. These specimens agree with the large type series described by Duellman and Trueb (1989) and provide a range extension of about 1250 km to the NNW of the previously reported northernmost specific locality, Cocha Cashu, Madre de Dios, Peru (Rodríguez, 1992), although Rodríguez and Duellman (1994) included the species in a guide to the frogs of the Iquitos region of Peru.

Hyla lanciformis (Cope)

This large treefrog was common at the margins of the lagoon and in the swamp at SJ, where males were calling from bushes and trees 0.5–1.0 m above the ground or water nearly every night between 30 May and 11 July. Two males were found more than 100 m away from water; one was on the leaf an *Aechmea* at night, and the other was caught in a Sherman live trap on a branch 1.5 m above the ground. Two individuals were perched on low trees in the forest at TL, and one was on a stick 1 m above the ground at night at NTL. Three adult females have SVLs of 71.0–78.4 (\bar{x} = 73.7) and masses of 19.5–23.0 (\bar{x} = 21.5); 13 adult males have SVLs of 52.9–71.2 (\bar{x} = 62.2) and masses of 8.9–20.0 (\bar{x} = 13.2). Two subadult females and one subadult male have SVLs of 56.1, 53.4, and 46.3 and masses of 10.0, 7.0, and 4.6, respectively. Three juveniles from SJ have SVLs of 24.6–38.7 (\bar{x} = 30.6) and masses of 0.6–3.1 (\bar{x} = 1.5). Two tadpoles in Stage 34 (Gosner, 1960), having body lengths of 8.7 and 9.0 and total lengths of 26.0 and 27.4, were in the swamp at SJ on 11 July. In life, they were pale tan with brown spots on the tail; they agree with the description provided by Duellman (1978). Two metamorphosing young, having SVLs of 14.0 and tail stubs of 1.5, were on reeds in the same pond on 9 July. The presence of calling males, gravid females, tadpoles, metamorphosing young, and juveniles of a wide range in size suggests that the breeding season is long.

Hyla leucophyllata (Bereis)

One female was on a leaf 1.0 m above the ground at night at TL, and all other individuals are from study zone at SJ, where a female was on a leaf 3 m above the ground at night and males were calling from leaves and branches of bushes 0.5–2.0 m above the edge of the lagoon on the nights of 2–11 July. Ten males have SVLs of 22.9–25.1 (\bar{x} = 23.9) and masses of 0.6–1.1 (\bar{x} = 8.8), and two gravid females have SVLs of 31.7 and 31.9 and masses of 2.4 and 2.9 g.

Hyla marmorata (Laurenti)

A gravid female having a SVL of 46.1 and a mass of 3.9 was perched on a fern at the edge of the forest at NTL on 18 July.

Hyla parviceps Boulenger

On 20 July, three males were observed leaping from leaf to leaf toward the forest pond at NTL at 2230 h; there had been a light rain just before dusk. No calling males were observed that night, but, on 21–24 July, males were calling from low vegetation in, and around the pond. On 22 July, males were calling from emergent vegetation in the temporary pond at TL. One gravid female was at the former pond on 21 July, and one spent female was on a branch of a tree 4 m above ground away from the pond. Two females have SVLs of 21.4 and 22.1 and masses of 0.7 (gravid) and 0.5 (spent), respectively; 10 males have SVLs of 15.4–17.9

(\bar{x} = 16.7) and masses of 0.2–0.3 (\bar{x} = 0.23). In life, the spots on the ventral surfaces of the arms and shanks are bright orange; the posterior part of the belly and ventral surfaces of the thighs are pale blue with black markings, and the spots on the flanks are white.

Hyla rhodopepla Günther

Males were calling from emergent vegetation in the forest pond at NTL on 20 July. Thirteen males have SVLs of 19.4–21.8 (\bar{x} = 20.8) and masses of 0.5–0.7 (\bar{x} = 6.38). In preservative, four specimens have reddish brown spots on the dorsal surfaces of the head, body, and shanks; the others are uniform creamy yellow.

Hyla riveroi Cochran and Goin

Males were calling from leaves of bushes and trees 0.5–1.5 m above the water in the swamp at SJ on 7 and 9 July and from leaves of bushes at the edge of the temporary pond at TL on 22 and 24 July. Seven males have SVLs of 15.6–17.5 (\bar{x} = 16.7) and masses of 0.2–0.3 (\bar{x} = 0.26); two females have SVLs of 17.8 and 18.0 and mass of 0.3. Living individuals at night were pale reddish brown with a dark brown dorso-lateral stripe and yellow vocal sac; by day, the dorsum was creamy tan with or without brown markings and a cream suborbital spot. In preservative, all specimens have dark brown canthal and postorbital stripes that extend to the mid-flank and a cream labial stripe (fragmented in two specimens). A dark brown interorbital bar is present in six specimens, and four have a middorsal dark stripe extending to the sacrum; this stripe is continuous with the interorbital bar in three specimens. One female (URP-WED 60484) deposited a clutch of 34 unpigmented eggs in a single layer of clear gelatin on the inside of a plastic bag.

Hyla sarayacuensis Shreve

Except for one male on the leaf of a bush 0.5 m above the ground at in the study zone at TL, all individuals were found at the temporary pond at NTL. One male was on a leaf by day, and all others were calling from leaves of bushes 0.5–1.0 m above the edge of the pond on the nights of 20 and 24 July. One postpartum female has a SVL of and a mass of 2.3; 23 males have SVLs of 24.4–28.7 (\bar{x} = 25.9) and masses of 0.7–1.2 (\bar{x} = 0.91).

Osteocephalus Steindachner

Generally four species of *Osteocephalus*—*buckleyi* (Boulenger), *leprieurii* (Duméril and Bibron), *subtilis* Martins and Cardoso, and *lawrimus* Steindachner—are recognized to occur in the upper Amazon Basin, and three additional species—*O. elkejungingorae* (Henle), *pearsoni* (Gäige), and *verruciger* (Werner)—are recognized on the Amazonian slopes of the Andes (Duellman, 1993). Close examination of the material collected in northern Peru reveals the existence of six species in the Amazon lowlands in Departamento

Loreto. In addition to the three species usually recognized there, there are two others for which names placed in the synonymies of *O. buckleyi* and *O. taurinus* by Trueb and Duellman (1971) are available. Another small species that breeds in bromeliads remains unnamed. An even smaller species, *O. rodriguezii* (Rivero) from the Guiana Highlands (Duellman and Hoogmoed, 1992) is now placed with five other small species from the Guiana Highlands in the genus *Tepuihyla* (Ayarzagüena et al., 1992).

Osteocephalus buckleyi (Boulenger)

One female (KU 221926) with flaccid, empty oviducts has a SVL of 50, and a mass of 5.4; it was on a branch of a bush about 1 m above the ground at night on 17 July in the study zone at NTL. In life, the dorsum was tan with brown blotches on the body and brown transverse bars on the limbs; the shanks were pale brown with distinct dark brown bars, and the anterior and posterior surfaces of the thighs were brown (Pl. 1). The throat and belly were cream with small brown spots, and the ventral surfaces of the hind limbs were tan. The margin of the upper lip was bronze-tan, and the iris was bronze with radiating black lines and a broad, median, horizontal reddish brown streak. The measurements and proportions, as well as the general features of structure and coloration, agree well with the type series (see Trueb and Duellman, 1971). The skin on the anterior part of the flank is distinctly areolate, and the axillary membrane is short and thick. The webbing formula for the hand is II $1\frac{1}{2}$ — $1\frac{1}{2}$ III 2^+ — 2^+ IV and for the foot I 1—1 II 1— 2^- III 1— $1\frac{1}{2}$ IV $1\frac{1}{2}$ —1 V.

Osteocephalus cabrerai (Cochran and Goin)

New combination

In their description of *Hyla cabrerai*, Cochran and Goin (1970) stated that the species was most closely related to *Hyla* (= *Osteocephalus*) *buckleyi*. The type locality—Caño Guacayá, tributary of the lower Río Apaporis, Departamento Amazonas, Colombia—is in the Amazon Basin east of northern Peru. This name was synonymized with *O. buckleyi* by Trueb and Duellman (1971). A single female (KU 221927) with small ovarian eggs and a mass of 3.1 was perched on a bush in the swamp at SJ on the night of 10 July. This individual is sufficiently different, especially in the coloration of the eye, to distinguish it from *O. buckleyi*. Comparison of this specimen with data on, and photographs of, the holotypes of the species synonymized with *O. buckleyi* by Trueb and Duellman (1971), revealed a striking similarity with the holotype of *Hyla cabrerai* (USNM 152759, a female).

Following are the characteristics of KU 221927 with characteristics of the holotype in parentheses: SVL 41.0 (52.7), tibia length 21.5 (31.0), head length 14.1 (18.3), head width 14.7 (19.2), eye 4.6 (5.2), tympanum 4.0 (4.0), webbing on hand II 2^- — 3^- III $2\frac{1}{2}$ — 2^+ IV (II $1\frac{1}{2}$ — 2^+ III 2^+ — $1\frac{1}{2}$ IV), webbing on foot I 1— 2^- II 1— 2^- III 1— 2^- IV 2^- —1 V (I 1— 1^+ II 1— $1\frac{1}{2}$ III 1— 2^- IV 2^- —1 V); vomerine teeth 9–8 (9–10). In

both individuals the snout is truncate in dorsal view, the nostrils protrude dorsolaterally, the supratympanic fold is tubercular, an axillary membrane extends to about the midlength of the upper arm, the digital discs are large and round (diameter of disc on third finger about two thirds diameter of tympanum), and rows of tubercles are present on the ventrolateral edges of the forearms and tarsi.

Structurally, the two specimens exhibit few differences. The dorsal skin is more tuberculate in the holotype, which has a weak inner tarsal fold that is lacking in KU 221927. The distal subarticular tubercle is bifid in the holotype and not in the other specimen. The nature of the dorsal skin and tarsal fold may be artifacts of preservation. The holotype evidently was dropped into preservative, whereas KU 221927 was laid out in a pan; the latter method tends to obscure tarsal folds. The nature of the distal subarticular tubercle on the fourth finger is variable in species of *Osteocephalus* (Trueb and Duellman, 1971). The holotype is larger and has slightly more webbing than KU 221927, but webbing is known to increase with size (Duellman, 1970).

The color pattern of the preserved specimens is nearly identical. Coloration in life of the holotype is unknown; color notes on KU 221927 when it was alive are: dorsum dark green with dark brown markings, viz., irregular interorbital bar, paired diagonal marks on occiput, transverse spot in cervical region, longitudinal marks on trunk, paired triangular marks in sacral region, transverse bars on limbs, and small labial spots (Pl. 1); flanks and ventral surfaces of limbs purplish brown; venter pinkish gray; posterior surfaces of thighs dark brown; tympanum copper; iris creamy orange.

Cochran and Goin (1970) designated two paratypes: WCAB 13284 from Amapá, Brazil and C. J. Goin 2317 from Vaupés, Colombia. The former is an example of *O. buckleyi*; the latter was not examined by Trueb and Duellman (1971). William W. Lamar collected one individual (not sexed) in Vaupés, Colombia; he compared it with the holotype of *O. cabrerai* and found them to be identical. He provided (W. W. Lamar: in lit.) the following field notes: "Collected 26 April 1979, along Caño Yapui (= Monserrero), a tributary of Caño Ti, which feeds the Vaupés River from the south. Collected by day on a twig next to wet bank over water. Color in life: when collected by day it was pale chartreuse and pale grey-beige which, combined with the warty skin gave the impression of lichen. By night the chartreuse areas became rich lime-green and all beige regions changed to deep maroon-brown. Iris bronzy-gold; eyelid with fine red-gold reticulations. Tympanum copper colored; digits also. Dorsal pattern complex, reticulate. Legs and thighs with three bars each. Pinkish white anal and heel tubercles and tarsal ridge. Ventrally dirty white, heavily spotted on upper chest and below mandible with maroon-brown becoming suffused cloudy tan from lower abdomen to thighs and legs. Warty tubercles along outer edge of hand and forearm to elbow. Bones green. SVL = 62.4 mm."

The major difference between the specimen from SJ and the one from Caño Yapui is in the apparent color of the iris, which can change with light intensity. The principal aspect

of coloration of the iris in *O. cabrerai* is the absence of radiating dark lines. Most other *Osteocephalus* have a bronze or greenish yellow iris with radiating black lines. *Osteocephalus elkjungiengeræ* from the lower slopes of the Andes in Peru has a dull red iris, but it is larger and has different coloration than *O. cabrerai* (Henle, 1992).

Osteocephalus leprieurii (Duméril and Bibron)

One male is from the study zone at SJ; two females and eight males are from the study zone at NTL. All were found at night; one male was on the forest floor; all other individuals were on stems of saplings and bushes or on branches of trees, 0.5–2.5 m above the ground. Nine males, all with keratinized nuptial excrescences, have SVLs of 44.2–50.1 (\bar{x} = 47.0) and masses of 4.3–6.4 (\bar{x} = 5.3); two gravid females have SVLs of 62.6 and 67.0, and masses of 14.0 and 17.6, respectively. Color notes on two living individuals (KU 221929, ♂, and 221930, ♀) are: Dorsum olive-tan with brown transverse marks on body and limbs; flanks cream with extension of dorsal transverse brown marks; anterior and posterior surfaces of thighs brown; narrow cream line above cloacal opening and on heel; venter pale tan; labial stripe cream; iris creamy tan with black flecks; bones green. The supra-cloacal stripe is absent in one individual and interrupted medially in two specimens. The venters are immaculate, except in one male that has brown flecks on the throat and another that has brown flecks on the chest. The webbing formula for the two outer fingers is III 2½—(2–2½) IV and for the fourth toe, 1½—2.

These specimens agree well with the detailed description of this species provided by Trueb and Duellman (1971) and Duellman (1978) except for some measurements and proportions. One female (KU 221930) having a SVL of 67.0 is larger than the previously reported maximum size of 64.0, and one male (KU 221931) having a SVL of 50.1 is larger than the previously reported maximum size of 49.0 (Duellman, 1978). Tibia length/SVL of nine males is 0.526–0.597 (\bar{x} = 0.553) in contrast to 0.514–0.571 (\bar{x} = 0.538) for 21 males given by Trueb and Duellman (1971). The range of variation of head width/SVL falls within the range given by Trueb and Duellman (1971), but head length is proportionately greater in all males—0.349–0.370 (\bar{x} = 0.358, n = 8) in contrast to 0.308–0.357 (\bar{x} = 0.335, n = 21) (Trueb and Duellman, 1971). The smallest male (URP-WED 60149) with a SVL of 44.2 has a proportionately large head—head length/SVL 0.414, head width/SVL 0.394. Also, our specimens have a greater tympanum/eye ratio—0.820–0.910 (\bar{x} = 0.862, n = 9 ♂♂) and 0.855–0.875 (\bar{x} = 0.865, n = 2 ♀♀) and in contrast to 0.652–0.884 (\bar{x} = 0.777, n = 21 ♂♂) and 0.698–0.909 (\bar{x} = 0.785, n = 21 ♀♀) (Trueb and Duellman, 1971).

Osteocephalus planiceps Cope

This name is resurrected from the synonymy of *Osteocephalus taurinus* Steindachner, 1862 (synonymy fide Trueb and Duellman, 1971). Cope (1874) based the description of *Osteocephalus planiceps* on a single specimen (ANSP 11399)

from Nauta, Departamento Loreto, Peru. The following diagnosis uses the numerical characters equivalent to those by Trueb and Duellman (1971): (1) Size large, sexual dimorphism moderate; maximum observed SVL in males 65.9, in females 85.9; (2) skin on dorsum in males bearing numerous, spinous tubercles, all about equivalent in size; (3) skin on flanks granular; (4) web extending to base of antepenultimate phalanx of Finger III; (5) dorsum brown, usually with darker transverse markings; (6) venter dull cream with or without small, diffuse, brown spots on chest; (7) narrow pale labial stripe confluent with broad, diagonal subocular mark; narrow, transverse, pale stripe on heels; narrow pale stripe above, and lateral to, cloacal opening; (8) flanks tan with small brown spots.

Osteocephalus planiceps is like *O. leprieurii* in having transverse marks on the dorsum and distinct labial, heel, and supra-cloacal stripes, but it differs by having dark spots on the flanks, larger and fewer tubercles on the dorsum in males, and smaller size. *Osteocephalus taurinus* is larger, has distinct dark spots or mottling on the venter, and lacks labial, heel, and supra-cloacal stripes. There is a subtle difference in the color of the iris; in *O. taurinus* it is greenish bronze with heavy black radiating lines, whereas in *O. planiceps* it is coppery bronze with fine radiating black lines. Furthermore, the tibia and head are proportionately longer and the tympanum proportionately larger in *O. planiceps* than in *O. taurinus* (see measurements below and Trueb and Duellman, 1971:Table 2). *Osteocephalus buckleyi* and *O. cabrerai* are smaller, have mixed large and small tubercles on the dorsum in males, areolate flanks, more webbing on the hand, and lack labial, heel, and supra-cloacal stripes; *O. subtilis* is smaller, has a proportionately smaller tympanum, and broad, transverse marks posteriorly on the dorsum (Martins and Cardoso, 1987). The unnamed, small, bromeliad-breeding species also lacks stripes and spots on the flanks and has more webbing on the hand.

In life, the dorsal ground color varies from dull tan to reddish brown; in 12 individuals, dorsal markings consist of dark olive green to dark brown transverse marks on the head, body, and limbs, whereas four females have a middorsal blotch anteriorly and transverse marks posteriorly, and one subadult female has an indistinct blotch in the scapular region and small dark spots on the rest of the body (Fig. 10). The flanks are dull to creamy tan with small, round dark brown or black spots. The anterior and posterior surfaces of the thighs are brown. The labial, heel, and supra-cloacal stripes are creamy white, and the venter is white to cream. The iris is coppery bronze with fine black radiating lines. Five of 11 females have small, diffuse grayish brown spots on the chest.

The following measurements and proportions are for three males (the first being the holotype) followed by the range (with mean in parentheses) for eight females: SVL 58.5, 64.6, 65.9, 60.5–85.9 (71.8); tibia length/SVL 0.549, 0.568, 0.539, 0.569–0.676 (0.611); head length/SVL 0.345, 0.351, 0.343, 0.334–0.391 (0.348); head width/SVL 0.320, 0.331, 0.318, 0.315–0.365 (0.327); tympanum/eye 0.816,



Fig. 10. *Osteocephalus*. Top—*O. planiceps*, KU 221936, adult male, 65.9 mm SVL. Middle—*O. taurinus*, KU 221941, adult female, 90.0 mm SVL. Bottom—*O. sp.*, KU 221943, adult male, 43.1 mm SVL.

0.806, 0.885, 0.822–0.901 (0.870). The webbing formula for the outer fingers is III (3⁻–3)–(2 $\frac{1}{2}$ –3⁻) IV, and the fourth toe has 1 $\frac{1}{2}$ –2 phalanges free of webbing. The holotype and 12 of the 17 new specimens have a bifid distal subarticular tubercle on Finger IV. The four largest females have SVLs of 74.5–85.9 (\bar{x} = 79.7) and masses of 21.4–30.0 (\bar{x} = 25.2); two adult males have SVLs of 64.6–65.9 (\bar{x} = 65.3) and masses of 12.7–15.5 (\bar{x} = 14.1)

Individuals were found at night in the study zones at SJ and NTL and in the floodplain forest at TL; most were on tree trunks or branches 1–5 m above the ground. One female was on a fallen palm stem 0.4 m above the water in the lagoon, and three females were at on bushes at the edge of the lagoon at SJ.

Osteocephalus taurinus Steindachner

This large treefrog is represented by two individuals from the study zone at SJ and three from TL. Two females were on trees 2–2.5 m above the ground at night. Two males were perched on poles in camp at night, and one male was on the ground in camp in open sunlight after a shower.

Three males have SVLs of 66.0–72.7 (\bar{x} = 70.1) and masses of 13.0–21.0 (\bar{x} = 17.0), and two females have SVLs of 75.7 and 90.0, and masses of 28.0 and 43.5, respectively. In measurements and proportions, these specimens fall within the ranges of variation of 59 males and 49 females reported by Trueb and Duellman (1971). All specimens have darkly mottled venters and lack white supraclacal, heel, and labial stripes; three individuals have dark spots on pale flanks, whereas the other two have uniformly dark flanks (Fig. 10). The webbing formula for the outer fingers is III (2⁺–2 $\frac{1}{2}$)–(2–2⁺) IV; 1.5 phalanges of the fourth toe are free of webbing. The distal subarticular tubercle on the fourth finger is bifid in four specimens.

Osteocephalus species

The existence of a small bromeliad-breeding *Osteocephalus* resembling *O. taurinus* has been recognized in central Amazonia for more than a decade (Zimmerman, 1983; Zimmerman and Bogart, 1984; Hödl, 1990); this species was described as *O. oophagus* from central Amazonas, Brazil by Junger and Schiesari (1995). What was at first thought to be the same species also has been observed at the junction of the Río Yanamono and Río Amazonas and at the Amazon Center for Environmental Education and Research near the junction of Río Sucusari and Río Napo, Loreto, Peru (WED, pers. obs.). The species was heard almost nightly in the study zones at SJ and NTL, as well as in the forest along the stream at TL, but most of the calls originated from high in the trees; one calling male was collected from a terrestrial bromeliad at 2120 h at TL on 17 July.

Having a mass of 4.4, this male has the following measurements: SVL 43.1, tibia length 22.5, head length 16.0, head width 15.1, eye 5.1, tympanum 3.0. The webbing formula for the outer fingers is III 2 $\frac{1}{2}$ –2⁻ IV; slightly less than two digits are free of webbing on the fourth toe. The distal subarticular tubercle on the fourth finger is distinctly bifid.

Crests on the lateral margins of the frontoparietals are distinct. Pale stripes are absent on the lips, heels, and above the cloacal opening; dark spots are absent on the flanks, and the venter is immaculate. Coloration in life: dorsum brown with faintly darker brown spots; flanks tan; anterior and posterior surfaces of thighs brown; shanks pale brown with indistinct brown bars; throat and belly cream; ventral surfaces of hind limbs tan; margin of upper lip bronze-tan; iris bronze with radiating black lines and broad, median, horizontal reddish brown streak (Fig. 10); bones white.

The combination of small size and white bones immediately distinguish this species from other *Osteocephalus*. The color of the iris and absence of an axillary membrane distinguish it from *O. cabrerai*; the smooth dorsum and flanks distinguish it from *O. buckleyi*, and the absence of pale stripes on the lips, heels and around the cloacal opening distinguish it from *O. lepriurii* and *O. planiceps*. It differs from *O. oophagus* by having more webbing on the hands and feet, white, instead of green, bones, and a different call. Males characteristically call from water-laden bromeliads; the call is a multiphasic series of notes resembling a laugh. This species, which is known from several localities in Departamento Loreto, Peru, apparently is unnamed.

Phyllomedusa Wagler

The collections contain three of the five species of this genus expected in the region; *P. bicolor* and *P. palliata* were not found. However, a single individual is referred to *P. coelestis*, formerly reported only from the holotype, and one specimen represents a new species in the *Phyllomedusa buckleyi* group, formerly unrecorded from the Amazon Basin.

Phyllomedusa coelestis (Cope)

An adult male (KU 221944) obtained at NTL on 20 July 1993 by Alfonso Miranda and Joseph R. Mendelson III apparently is the first specimen recorded since Cope's (1874) description of the species, which was based on a single male from Moyobamba, Peru. The new specimen was compared with the holotype (ANSP 11384). Because this species has not been identified formerly in the Amazonian anuran fauna, a full diagnosis and description are provided.

Diagnosis.—A member of the genus *Phyllomedusa* (*sensu stricto*, Cruz 1990) defined by the following combination of characters (numbered characters follow Duellman, 1974): (1) snout truncate above, inclined anteroventrally in profile; (2) parotoid glands diffuse or elevated, rounded, not protruding dorsolaterally, extending to midlength of body; (3) dorsal skin shagreen with or without tubercles on limbs; osteoderms absent; (4) first finger shorter than, and opposable to, second; (5) first toe longer than, and opposable to, second; (6) discs on fingers small; (7) forearm much more robust than upper arm; (8) calcar absent; (9) cloacal opening directed posteroventrally at midlevel of thighs; (10) dorsal surfaces and side of head green; (11) flanks green with creamy white, vertical ellipsoids; (12) anterior and posterior surfaces of thighs colored like flanks; (13) throat and chest grayish brown; belly pale orange; (14) ulnar,

tarsal, supraclacal stripes and margins of upper eyelid and lower jaw creamy white; (15) iris black with coppery reticulations; (16) palpebrum clear; (17) SVL GG 53.3–64.8.

Of the other 10 nominal species of *Phyllomedusa* in the Amazon Basin, five species differ from *P. coelestis* by having a cream or white iris; of these, *P. atelopoides* is a smaller, brown, terrestrial species, *P. hulli* is a smaller species lacking parotoid glands and markings on the flanks and limbs, *P. tomopterna* has calcars and bright orange-yellow flanks and hidden surfaces of the limbs with vertical brown or lavender bars, *P. vaillanti* has elevated, angular parotoid glands extending to the sacrum and a longitudinal row of white granules along the angle of the gland, and *P. bicolor* is much larger with parotoid glands elevated dorsolaterally and small creamy white spots bordered by black on the flanks and anterior and posterior surfaces of the thighs. *Phyllomedusa boliviana* and an unnamed species resembling *P. boliviana* have a pale labial stripe extending onto the flank, a faintly reticulated venter, and black iris with gold or coppery reticulations (iris black in unnamed species). In *P. palliata* the venter and flanks are cream with brown flecks and the iris is bronze with fine black reticulations; the iris is similarly colored in *P. hypocondriialis*, which has the flanks and hidden surfaces of the thighs orange with black bars and the venter white with black flecks on the chest. *Phyllomedusa tarsius* is most like *P. coelestis*, but in *P. tarsius* males are much larger (SVL 81–90, $\bar{x} = 84.1$, $n = 20$), the pattern on the flanks consists of small, irregular pale marks, and males lack vocal slits.

Description.— $n = 2 \sigma\sigma$ (data for holotype, if different, in parentheses). Body robust; head about as wide as long; snout moderately short, nearly truncate in dorsal view, rounded above and slightly inclined anteroventrally in profile; nostrils protuberant, directed laterally, at level of anterior margin of lower lip; internarial region slightly depressed; canthus rostralis straight, rounded and slightly elevated in section; loreal region barely concave; lips rounded, not flared; top of head flat, slightly depressed below level of canthi; interorbital distance greater than width of upper eyelid; eye large, protuberant; pupil vertically elliptical; palpebrum clear; parotoid gland distinct, elevated, rounded in section, extending from upper eyelid to about midlength of body (diffuse), followed posteriorly by four large, round pustules (absent); supratympanic fold absent; tympanum distinct, round, separated from eye by distance about one half diameter of tympanum.

Axillary membrane absent; upper arm slender; forearm moderately robust; row of low tubercles on ventrolateral edge of forearm from elbow to wrist; fingers long, lacking webbing and lateral fringes; discs small, round; disc on Finger III about one half size of tympanum; relative lengths of fingers I < II < IV < III; first finger opposable to second; subarticular tubercles large, round, elevated; supernumerary tubercles present only on proximal segments of Fingers II–IV, nearly equal in size and shape to subarticular tubercles; palmar tubercle diffuse, barely elevated; thenar tubercle large, elliptical, elevated, bearing pigmented, but not keratinous, nuptial excrescence on inner and dorsal surfaces (Fig. 11).

Hind limb slender; calcar and tubercles on heel absent; transverse dermal fold on heel continuous with row of tubercles on outer edge of tarsus; inner tarsal fold absent; row of low tubercles on ventral surface of tarsus; outer metatarsal tubercle absent; inner metatarsal tubercle small, ovoid, not visible from above; toes long, lacking webbing and lateral fringes; discs round, slightly smaller than those on fingers; relative lengths of toes II < I < III < V < IV;

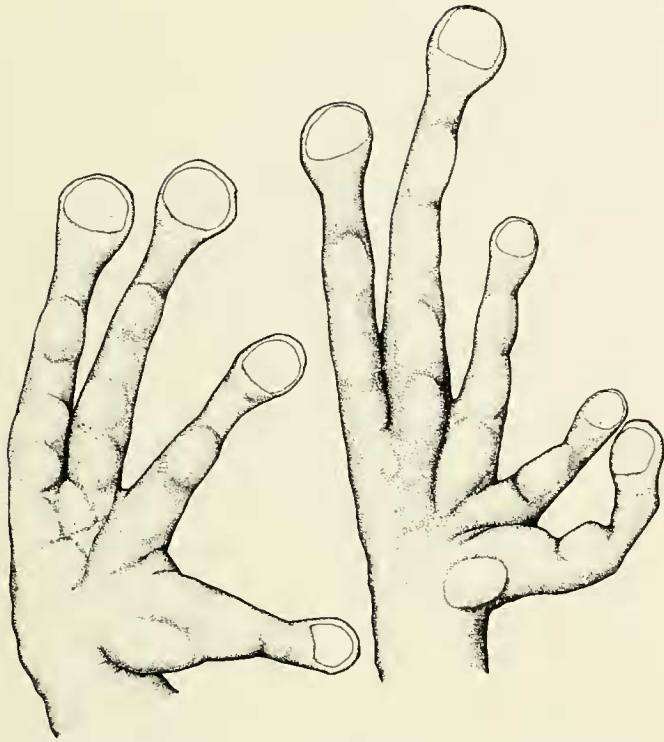


Fig. 11. Hand and foot of *Phyllomedusa coelestis*, KU 221944. Scale bar = 1 mm.

first toe opposable to second; subarticular tubercles large, round; supernumerary tubercles present only on proximal segments, large, nearly equal to subarticular tubercles (Fig. 11).

Cloacal opening directed posteroventrally at midlevel of thighs; cloacal sheath short, unmodified; clusters of para-anal tubercles absent. Skin on dorsal surfaces of head, body, and limbs shagreen with round tubercles on thighs and shanks (small on thighs, absent on shanks); skin on flanks areolate with (without) scattered low tubercles; skin on throat, chest, belly, and ventral surfaces of forearms and thighs coarsely granular; other surfaces smooth; osteoderms absent; row of low, white tubercles on ventral surfaces of thighs—5 on right, 4 on left (4 on each); proximal tubercle on each thigh much larger than others (2nd on right largest); row of low, white tubercles on ventral surfaces of tarsi—4 on right, 2 on left (indistinct). Tongue broadly lanceolate, shallowly notched posteriorly, free behind for about 40% of its length. Dentigerous processes of vomers bearing teeth—5 on right, 4 on left (4–1), angled posteromedially, located between moderately large, rectangular choanae, moderately separated medially. Vocal sac single, median, subgular; vocal slits short, extending anteromedially from angle of jaw.

Color in preservative: Dorsum dull blue, parotoid glands darkest (no distinction); seven creamy white, vertical ellipsoids (irregularly quadrangular) on each flank; creamy white, vertical ellipsoids (irregular marks) on hidden surfaces of limbs—2 (1) on upper arms, 4 each on forearms (distal ones coalesced) and tarsi, 5 each on anterior (4 with distal ones coalesced) and posterior surfaces of thighs and inner and outer surfaces of shanks; dorsal surfaces of Fingers III and IV and Toes III–V dull blue, of Fingers I and II and Toes I and II cream with brownish blue transverse marks; discs on Fingers I and II and on Toes I–III primarily

cream, on Fingers III and IV and on Toes IV and V primarily dark blue. Throat and chest dark brown with small white spot medially on throat (absent) and large white spot (two spots) medially on chest; belly creamy-white laterally, brownish gray anteriorly—with three small white spots medially (absent), dull orange (cream) posteriorly; ventral surfaces of arms and hands cream, with gray suffusion on fingers; ventral surfaces of thighs cream anteriorly and gray posteriorly, of tarsi and feet gray. Creamy white stripes on margin of upper eyelid and on margin of lower jaw extending posteriorly to, or nearly to, first ellipsoid on flank (continuous with first vertical mark); transverse creamy white stripes above cloacal opening and on heels; creamy tan stripes on ventrolateral edges of forearms and tarsi.

Color in life: Dorsum green with pale creamy white ellipsoids on flanks and hidden surfaces of limbs; throat and chest dark grayish brown; belly pale, dull orange; iris black with coppery reticulations (Fig. 12).

Measurements: SVL 64.8 (53.3), tibia length 31.4 (25.5), foot length 22.6 (17.8), head length, 23.0 (18.2), head width 22.8 (17.6), interorbital distance 8.4 (6.7), internarial distance 5.1 (4.7), eyelid width 6.4 (5.3), eye-nostril 6.1 (4.8), eye 6.9 (5.3), tympanum 4.0 (3.5).

Remarks.—The holotype is in reasonably good condition although it is soft, and the skin is loose. Most of the discrepancies between the holotype and the new specimen are in dermal characters (pustularity and parotoid glands), the distinctness of which can be due to preservation. However, Cope (1974:121) stated: "... no trace of parotid gland or line of crypts." The distinctness of the parotoid glands is variable in some species of *Phyllomedusa*; as noted by Duellman (1974) in some specimens of *P. tarsiis* the glands are diffuse and barely noticeable, whereas in others that are distinct and elevated.

Cope's (1874:121) description of coloration—"Superior surfaces blue, sides yellow, with vertical purple bars. Concealed surfaces light maroon, with yellow spots; on the posterior face of the femur in two series. Belly and throat sea-green, unspotted. Lower lip yellow bordered; upper lip without markings. Upper eyelids yellow bordered."—is at some variance with the holotype and with the new specimen. A pair of distinct white spots are present on the chest. The



Fig. 12. *Phyllomedusa coelestis*, KU 221944, adult male. 64.8 mm SVL.

“sea-green” ventral coloration has been observed in some *P. vaillanti*, but in the new specimen, the throat and chest were brownish gray, and the belly was dull orange. Evidently the stripes and spots that were creamy white in the new specimen and are now white in the holotype were yellow in the holotype when Cope examined the specimen. Cope’s “vertical purple bars” are the interspaces (continuous with the dorsal coloration) between the vertical pale marks on the flanks.

The new specimen, having a mass of 13.0, was perched on the limb of a tree 3 m above ground in the study zone NTL at night (2025 hr). Other species of *Phyllomedusa* found at the same locality are *P. hulli*, *tarsius*, *tomopterna*, and *vaillanti*. The type locality of *P. coelestis* is Moyobamba, 830 m, at the base of the Andes about 465 km SSW of TL.

Cochran and Goin (1970) reported a specimen (MLS 62, sex unknown, SVL 62.6 mm) from La Providencia, Departamento Caquetá, Colombia, that they referred to *P. boliviana* Boulenger. Photographs of this specimen (Cochran and Goin, Pl. 40) show a lateral color pattern like that of *P. coelestis*. It is likely that this specimen represents a third locality for *P. coelestis* rather than an Amazonian record for *P. boliviana*, which otherwise has been reported only from semiarid regions of Bolivia, Paraguay, and northern Argentina.

Phyllomedusa hulli new species

Holotype.—URP-WED 60198, an adult male, from forest pond at 1.5 km N Teniente López, Provincia Loreto, Departamento Loreto, Peru (02°35'38.9"S, 76°07'02.0"W, 310 m), obtained on 19 July 1993 by Joseph R. Mendelson III and Alfonso Miranda.

Diagnosis.—A member of the *Phyllomedusa buckleyi* group as defined by Cannatella (1980) with the following combination of characters: (1) foot webbing II 2⁺—3.5 IV 3⁺—2 V; (2) calcar absent; snout sloping in profile; (4) para-anal tubercles present; (5) outer metatarsal tubercle absent; (6) white dorsal pustules present; (7) quadratojugal present; (8) sacro-coccygeal articulation bicondylar.

In comparison with other members of the *Phyllomedusa buckleyi* group (Cannatella, 1980, plus *P. danieli* provisionally placed in the group by Ruiz-Carranza et al, 1988), *P. hulli* is unique in having coarsely granular skin on the dorsum. The dorsal skin is finely granular in *P. buckleyi* and *P. medinai* (smooth in the other species); the former has a smaller tympanum (tympanum/eye = 0.329–0.375, \bar{x} = 0.352, n = 10) that is barely evident, whereas the larger tympanum (tympanum/eye = 0.489) is distinct in *P. hulli*. Furthermore, *P. buckleyi* differs from *P. hulli* by having small calcar and usually having a small outer metatarsal tubercle; *P. psilopygion* has a large calcar, no para-anal tubercles, and a truncate snout (also truncate in *P. lemur*). *Phyllomedusa danieli* is a doubtful member of the group because of its large size (80 mm), toes basally webbed, and yellow iris; the other species have a white iris, toes about one-fourth to one-third webbed, and maximum snout-vent lengths in males of 34.7–44.5.

Description.— n = 1. Head barely wider than body; snout short, narrowly rounded in dorsal view, sloping anteriorly from level of nostrils to margin of lip in profile; nostrils moderately protuberant, directed dorsolaterally, at level posterior to anterior margin of lower jaw; internarial region slightly depressed; canthus rostralis straight, acutely rounded in section; loreal region slightly concave; lips thin, not flared; top of head flat; interorbital distance greater than width of upper eyelid; eyes large, protuberant; pupil vertically elliptical; palpebrum clear; parotoid glands not differentiated; supratympanic fold thin, extending to point above angle of jaw, not obscuring upper edge of tympanum; tympanum round, distinct with slightly elevated annulus, separated from eye by distance equal to two thirds diameter of tympanum.

Axillary membrane absent; upper arm slender; forearm moderately robust; dermal fold from elbow to base of disc on Finger IV narrow, slightly crenulate; fingers moderately short, flattened in section, lacking webbing but having narrow lateral fringe on each side of each digit; discs round; diameter of disc on Finger III equal to diameter of tympanum; relative lengths of fingers I < II < IV < III; distal subarticular tubercles conical; proximal subarticular tubercles round, barely elevated; supernumerary tubercles diffuse, present only on proximal segments of digits; palmar tubercle diffuse; thenar tubercle elliptical, poorly differentiated; thin, keratinous nuptial excrescence on dorsal surface of basal part of thumb (Fig. 13).

Hind limb slender, long; calcar and tubercles on heel absent; outer tarsal fold distinct, crenulate, extending from heel to base of disc on Toe V; inner tarsal fold absent; outer metatarsal tubercle absent; inner metatarsal tubercle low, elliptical, visible from above; toes moderately long with distinct lateral fringes, about one-fourth webbed; webbing formula III 2⁺—3.5 IV 3⁺—2 V; relative lengths of toes I < II < III < V < IV; discs round, about equal in size to those on fingers; distal subarticular tubercles conical; proximal subarticular tubercles round, elevated; supernumerary tubercles indistinct (Fig. 13).

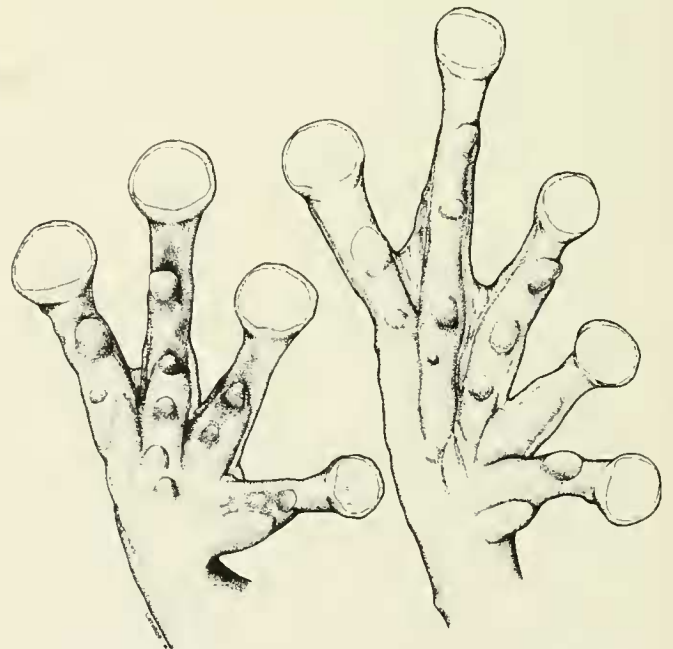


Fig. 13. Hand and foot of *Phyllomedusa hulli*, URP-WED 60198. Scale bar = 1 mm.

Cloacal opening directed ventrally at lower level of thighs; cloacal sheath long; para-anal tubercles present. Skin on dorsal surfaces, except upper arms and digits coarsely granular; skin on belly weakly granular; skin on other surfaces smooth; one white, elevated wart on body; osteoderms absent. Tongue lanceolate, nearly three times as long as wide, distinctly notched posteriorly, free behind for about one half of its length. Dentigerous processes of vomers each bearing three teeth, angled posteromedially between large reniform choanae, moderately separated medially. Vocal sac single, median, subgular; vocal slit extending from mid-lateral base of tongue nearly to angle of jaw.

Color in preservative: Head and dorsum of body, limbs (except upper arms), and proximal parts of Finger IV and Toes IV and V dark, dull blue with scattered pale blue flecks; upper arms, flanks, belly, and other surfaces of limbs and digits cream; throat, margin of upper lip, ulnar and tarsal stripes, para-anal tubercles, and lower edge of cloacal sheath white.

Color in life: At night dorsum dark green with small, pale green flecks. By day dorsum pale green; flanks and hidden surfaces of limbs orange; chin, belly, and labial, ulnar, tarsal, and infra-cloacal stripes white; iris cream (Pl. 1).

Measurements: SVL 37.1, tibia length 18.6, foot length 13.5, head length 24.0, head width 14.1, interorbital distance 5.2, internarial distance 3.0, eyelid width 4.2, eye-nostril 3.9, eye 4.5, tympanum 2.2; mass 1.5 g.

Etymology.—The specific name is a patronym for Dr. Clark Hull, Environmental Manager, Occidental Petroleum Company of Peru; his broad outlook on environmental issues sets an outstanding example.

Remarks.—The holotype was perched on a leaf of a vine 4 m above the ground; the vine was attached to a tree at the edge of the forest pond NTL. The frog was collected at 2225 hr. This pond was visited nightly for nine nights (16–24 July); no other individuals were observed nor was any unknown phyllomedusine call heard. During this time four male *Phyllomedusa tarsius* were found in trees near the pond and four species of *Hyla* (*H. koehlini*, *parviceps*, *rhodopepla*, *sarayacuensis*) were calling from bushes and low herbs in, and around, the pond.

This is the only species of the *Phyllomedusa buckleyi* group known from the Amazon Basin. The other species are mostly confined to cooler montane forests, but *P. buckleyi* ranges from 400–1870 m on the Amazonian slopes of the Andes in Ecuador, and *P. psilopygion* occurs at elevations of 100–300 m on the Pacific lowlands of Colombia (Cannatella, 1980).

Phyllomedusa tarsius (Cope)

Five adult males having well-developed, dark brown nuptial excrescences have SVLs of 82.2–88.7 (\bar{x} = 85.6) and masses of 20.0–30.0 (\bar{x} = 27.4). The parotoid glands are diffuse in three individuals and elevated, round, and extending to midlength of the body in two individuals. One was perched on a tree limb 1.5 m above the ground at night in the study zone at SJ. Four were on limbs of trees 1.5–4.0 m above the ground near the forest pond NTL.

Phyllomedusa tomopterna Cope

One adult male with well-developed nuptial excrescences

and having a SVL of 45.0 and mass of 3.5 was in a bush at the edge of the forest clearing at SJ at night. Of two individuals from the study zone NTL, one gravid female having a SVL of 56.6 and mass of 9.5 was on a palm frond 1.2 m above the ground at night on 24 July; the other individual, a juvenile having a SVL of 28.4 and mass of 0.9 was on a leaf 1.5 m above the ground at night on 17 July.

Phyllomedusa vaillanti Boulenger

With the exception of one adult male having a SVL of 59.9 and a mass of 9.6 found on a leaf 1.2 m above the ground at night at NTL, all adults are from SJ, where most were found adjacent to the lagoon at the edge of the study zone. Three small males (SVL = 48.4, 48.8, 49.4; mass = 3.1, 5.6, 5.0) with weakly developed nuptial excrescences were calling from bushes and trees 0.5–1.5 m above the edge of the water on the night of 5 July. A large adult male (SVL = 53.3, mass = 8.0 g) was on a bush at the edge of the lagoon on 8 July. Only two females were found; a gravid individual having a SVL of 81.5 and a mass of 31.0 was walking on the ground near the lagoon on 2 July. A small female (SVL = 48.2, mass = 4.8 g) containing small ovarian eggs was in a bush about 200 m from the lagoon on 10 July. A juvenile having a SVL of 35.0 and a weight of 1.7 gm also was found on 10 July.

Many metamorphosing and recently metamorphosed young were observed on the ground and on vegetation up to 3 m above the ground near the lagoon at SJ on the nights of 30 June–5 July; 14 individuals with partial tails have SVLs of 20.3–23.6 (\bar{x} = 21.6), tail lengths of 1.2–16.6 (\bar{x} = 7.1), and masses of 0.8–1.7 (\bar{x} = 1.3), whereas nine individuals without tails obtained on 10 July have SVLs of 22.8–26.3 (\bar{x} = 24.5). Ten recently metamorphosed young found at the oxbow lake at TL on 16–23 July have SVLs of 28.2–37.7 (\bar{x} = 30.1) and weights of 1.0–2.7 (\bar{x} = 1.4). Even the smallest of these have the distinctive dorsolateral row of tubercles, which in small individuals are rusty orange instead of white, as they are in larger individuals. In the metamorphosing young the dorsum is dark green, the venter grayish white with pale green spots on the chest, and the iris silver.

The presence of small calling males, large calling males, a gravid adult female, a subadult male and female, and young of various sizes suggest a long reproductive season in this species.

Scinax cruentomma (Duellman)

Of four individuals from TL, one adult male (SVL 23.0, mass 0.3) was on emergent vegetation in a temporary pond at night, one gravid female (SVL 27.7, mass 1.0) was on a leaf 0.5 m above ground in the flood plain forest at night, one subadult male (SVL 19.9, mass 0.2) was on a leaf 2 m above the edge of the oxbow lake at night, and one subadult female (SVL 23.0, mass 0.7) was under a board in a clearing by day. In life, the adults were green with darker green stripes, and the posterior surfaces of the thighs were dark brown; the venter was creamy white, and the iris was bronze with a horizontal red streak.

Scinax funerea (Cope)

Two gravid females having SVLs of 39.9 and 37.6 and masses of 3.4 and 3.8 were perched on branches 5 and 3 m above the ground at night in the study zone at SJ and in the flood plain forest at TL, respectively. At night at the forest pond NTL a spent female having a SVL of 37.7 and a mass of 2.5 was observed running up the trunk of a sapling. Color notes on gravid females in life are: KU 221960—Dorsum pale olive green with dark olive green markings; flanks creamy yellow with black markings; iris coppery bronze. KU 221961—Dorsum mottled reddish brown and dark brown; flanks yellow with dark brown spots; anterior and posterior surfaces of thighs dark brown with pale green streaks; throat and belly dirty cream; ventral surfaces of limbs pale green; iris bronze.

Scinax garbei (Miranda-Ribeiro)

Males were calling from vines and leaves of bushes at the edge of the lagoon at SJ on 1–5 July; some called from a horizontal position, and others were head down. Seven males have SVLs of 32.8–34.9 (\bar{x} = 33.7) and masses of 1.4–2.0 (\bar{x} = 1.76). A single female from the same lagoon has a SVL of 38.5 and a mass of 2.6. The bars on the limbs are pale orange in life, and the snout has a pronounced tubercle; in these characters they are like specimens from Santa Cecilia, Ecuador, but they are slightly smaller (Duellman, 1978). They are quite different from specimens from the junction of the Río Yanamono and Río Amazonas, Loreto, Peru, which have less tuberculate skin, no prominent tubercle on the snout, and red bars on the limbs (Duellman and Wiens, 1993). Furthermore, these specimens (KU 220342–45, 220432–33) are larger; 3 males have SVLs of 34.9–39.2 (\bar{x} = 37.2) and three females have SVLs of 45.0–49.1 (\bar{x} = 46.7).

Scinax rubra (Laurenti)

This species was abundant in clearings at the camps at SJ and TL; individuals were found by day under cover and at night on buildings and in grassy areas, where males called from sticks and vegetation above shallow water. One male with a mass of 1.6 g in grass at night had a dragonfly in its mouth. One gravid female was at the edge of the oxbow lake at TL at night. Thirteen adult males have SVLs of 25.4–35.0 (\bar{x} = 30.3) and masses of 1.3–1.8 (\bar{x} = 1.56); eight gravid females have SVLs of 34.5–40.7 (\bar{x} = 37.9) and masses of 2.1–3.3 (\bar{x} = 2.8).

Duellman and Wiens (1993:39) noted "... specimens from the lower Río Pastaza drainage, Ecuador, are smaller than 'typical' *S. rubra* in the upper Amazon Basin. Also, some specimens from the western edge of the Amazon Basin in Departamento San Martín [Peru] are larger, lack dorsolateral stripes, and have diffuse yellow spots on the posterior surfaces of the thighs." The specimens from SJ and TL are variable in size and color pattern. The range and mean in SVL of these specimens is greater than in a series of 17 males

from Santa Cecilia, Ecuador—29.4–33.8 (\bar{x} = 32.1); all of these specimens have dorsolateral stripes. Only 12 (52%) of the specimens from SJ and TL have dorsolateral stripes. The dorsum in the others is olive brown to brown with tan to pale gray mottling. The yellow spots on the posterior surfaces of the thighs are diffuse in nine specimens, four of which have dorsolateral stripes. Thus, the specimens from SJ and TL have combinations of features, individual ones of which are characteristic of populations of *S. rubra* to the north, west, and southwest.

LEPTODACTYLIDAE

Adelophryne

The genus *Adelophryne* was proposed by Hoogmoed and Lescure (1984) for two new species of minute leptodactylid frogs having flattened digits, asymmetrically pointed discs with lateral grooves on the toes, fourth finger reduced in size with only two or three phalanges and one subarticular tubercle. Three additional species were named from northeastern Brazil by Hoogmoed et al. (1994). The present specimens, which exhibit greater digital reduction and have only three functional digits on the hand and foot, obviously represent an undescribed species that is tentatively placed in *Adelophryne*. For ease of comparison, the following diagnosis and description follow the format of Hoogmoed and Lescure (1984).

Adelophryne tridactyla new species

Holotype.—URP-WED 59953, an adult male, from San Jacinto, 190 m, Departamento Loreto, Peru, obtained on 7 July 1993 by Richard A. Leschen.

Referred specimen.—KU 221992, an adult female, from 1.5 km N Teniente López, (02°35'39.0"S, 76°06'59.0"W, 340 m), Provincia Loreto, Departamento Loreto, Peru, obtained on 17 July 1993 by Joseph R. Mendelson III.

Diagnosis.—A minute frog (maximum SVL 12.4) with Finger I not evident externally, Fingers II and IV greatly reduced; Toe I not evident externally, Toe II reduced to tubercle; Toes III and IV greatly reduced; tips of digits asymmetrically pointed; skin on dorsum finely shagreen, flanks and belly black with cream spots.

Adelophryne tridactyla differs from its congeners by having only three externally visible digits on the hand and foot, presence of elliptical tubercle on proximal outer edge of tarsus and lateral fringes on toes, proportionately larger tympanum, and in coloration. *Adelophryne adiasola*, *barturitisensis*, and *gutturosa* lack pale spots on the flanks, whereas *A. pachydactyla* has white flecks on the dorsum and *A. maranguapensis* has a dark hourglass-shaped or X-shaped mark on the dorsum.

Description.— $n = 1 \text{ } \text{♀}$, $1 \text{ } \text{♂}$, SVL to 12.4 mm; head slightly wider than long, not as wide as body. Snout long; eye-nostril distance less than diameter of eye; snout bluntly rounded in dorsal view, rounded above and inclined posteroventrally in profile; canthus rostralis indistinct, straight, curved in section; loreal region flat,

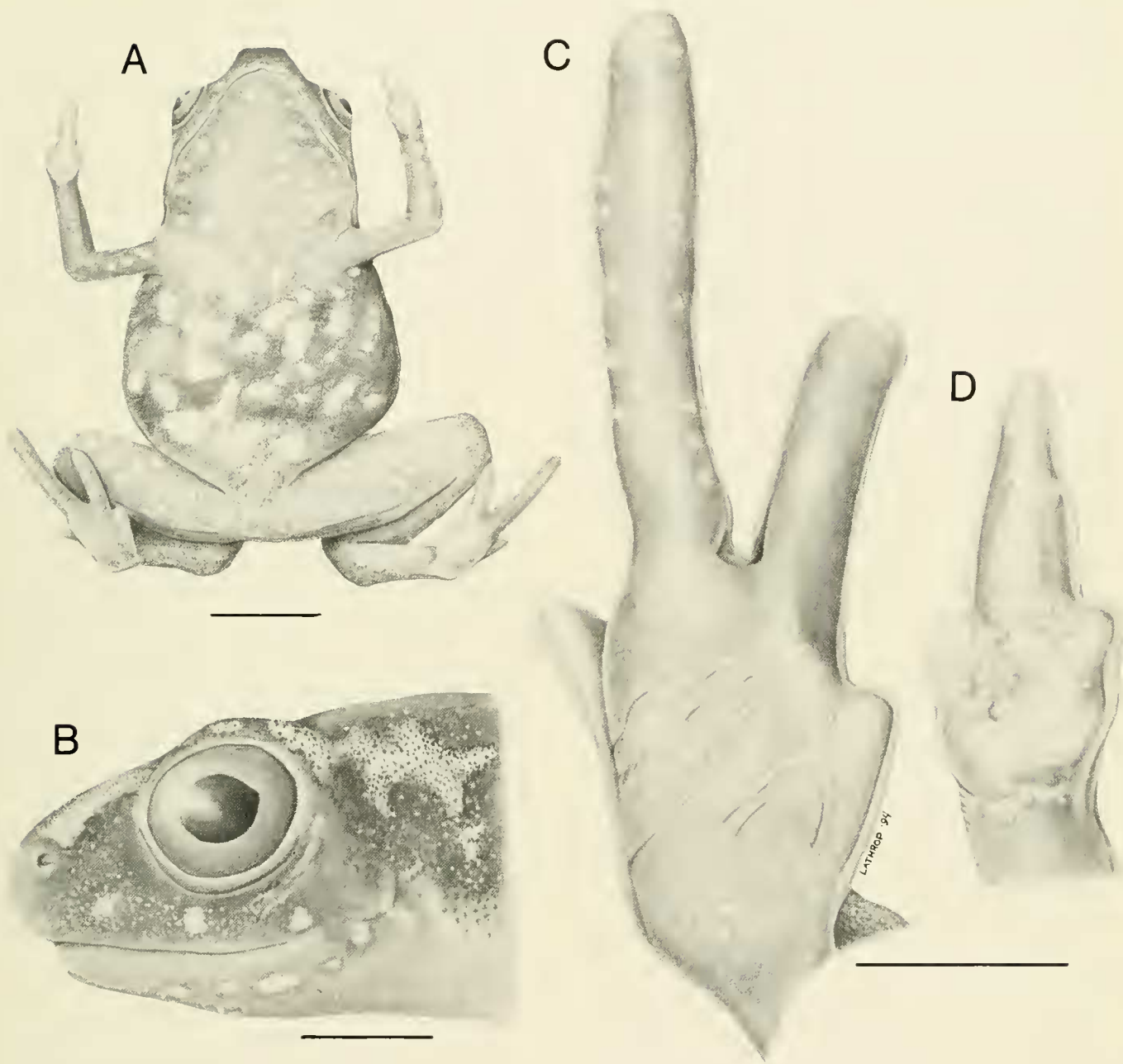


Fig. 14. *Adelophryne tridactyla*, KU 221992, adult female, 11.5 mm SVL. A. Venter. B. Side of head. C. Plantar view of foot. D. Palmar view of hand. Scale bars: A = 2 mm; B–D = 1 mm.

in continuous plane with lips. Nostrils below level of canthus, not protuberant, directed laterally at level of anterior margin of lower jaw; internarial area not depressed. Top of head slightly convex; interorbital distance more than 1.5X width of upper eyelid; eye large, not greatly protuberant; pupil horizontally elliptical. Temporal region vertical; tympanic annulus distinct except posterodorsally where obscured by diffuse supratympanic fold; diameter of tympanum about two-thirds that of eye, separated from eye by distance about one-third diameter of tympanum (Fig. 14).

Dentigerous processes of vomers each bearing 5 or 6 teeth,

straight, barely separated medially, located at level between orbits and well posterior to small, ovoid choanae. Tongue lanceolate, not notched posteriorly, attached only anteriorly. Vocal slits long, extending anteromedially from angle of jaw.

Skin on dorsum finely shagreen; that on flanks and venter smooth; discoidal fold absent; folds on wrists and heels, and below tympanum absent. Cloacal aperture a puckered opening directed posteriorly at upper level of thighs.

Hand with large, padlike palm composed of diffuse tubercles; two indistinct subarticular tubercles on Finger III; Fingers II and

III equal in length, short, blunt, completely fused with Finger III; Finger I not evident externally. Finger III with lateral fringe, pointed terminally, without disc (Fig. 14). Nuptial excrescences absent. Phalangeal formula 1-1-3-1; terminal phalanges pointed.

Elliptical tubercle on proximal outer edge of tarsus (otherwise, tarsus smooth); inner metatarsal tubercle small, diffuse; outer metatarsal tubercle absent; subarticular tubercles indistinct; basal plantar surface padlike. Tips of toes dilated into small, asymmetrical discs, slightly wider than toes, lacking circumferential grooves; toes depressed, unwebbed, but with lateral fringes; relative lengths of toes II < V < III < IV. Phalangeal formula (viewed in radiographs) 1-1-3-4-2; terminal phalanges pointed (Fig. 14). When hind limbs flexed at right angles to longitudinal plane of body, heels touch but do not overlap; tibia length 41-43% of SVL.

Measurements: Holotype, KU 221992; SVL 12.4, 11.5; tibia length 5.1, 5.0; foot length 4.4, 4.2; head length 3.6, 3.6; head width 4.0, 4.1; interorbital distance 1.6, 1.6; eyelid 0.9, 1.0; internarial distance 1.0, 1.0; eye-nostril 1.2, 1.1; eye diameter 1.6, 1.5; tympanum diameter 1.0, 0.9; eye-tympanum 0.3, 0.3.

Coloration in preservative: Dorsum of head, body, and limbs brown with pale tan spots and flecks; narrow creamy tan canthal stripe extending along outer edge of upper eyelid and continuous with irregular creamy tan dorsolateral stripe, bordered by dark brown, extending from posterior edge of eyelid to groin; flanks and belly dark brown with large bluish white spots (Fig. 8); upper lip, throat, ventral surfaces of limbs, and anterior and posterior surfaces of thighs brown with cream flecks.

Coloration in life: KU 221992—Dorsum of head, body, and limbs dark brown with cream flecks and narrow cream canthal and dorsolateral stripes; flanks and belly black with cream spots; throat and ventral surfaces of limbs brown with cream flecks; anterior and posterior surfaces of upper arm orange-tan; iris red (Pl. 1).

Etymology.—The specific epithet is an adjective derived from the Greek *daktylos* meaning finger or toe and the Greek prefix *tri-* meaning three; the name refers to the presence of only three functional digits on the hand and foot.

Ecology.—Both individuals were in primary forest. The holotype was in a pan of preservative below an insect-flight intercept trap early in the morning, and the other individual was in a pitfall trap at 2225 h. Both specimens have small ants in their stomachs.

Remarks.—Six specimens (MPEG 5304-05, 5637; RMNH 26812-14) from Tabatinga, Estado Amazonas, Brazil, are like *A. tridactyla* in having reduced digits on the hands and feet. Pending further study, these specimens are tentatively referred to *A. tridactyla*. Tabatinga is about 700 km ESE of San Jacinto.

Comparison of the two specimens of *A. tridactyla* with two of *A. adiastrata* (KU 220475, 220564) from Quebrada Vásquez, north side of lower Río Tahuayo, Departamento Loreto, Peru (first Peruvian record) reveals that the latter are slightly larger (SVL 14.1, 14.4), have more granular skin on the dorsum, which is nearly uniform dark brown with no pale canthal and dorsolateral stripe, and hands and feet as described for the type series of *A. adiastrata* by Hoogmoed and Lescure (1984).

Examination of radiographs of the type series of *A. tridactyla* and the two specimens of *A. adiastrata* showed the phalangeal reduction described in *A. tridactyla* and the phalangeal formula in *A. adiastrata* to be 2-2-3-2 in the

hand and 2-2-3-4-2 in the foot. Thus, these two specimens of *A. adiastrata* have phalangeal reduction in the foot, as compared with the type series, in which the phalangeal formula is 2-2-3-4-3 (Hoogmoed and Lescure, 1984). According to Hoogmoed et al. (1994), the phalangeal formulae for the hands of *A. barturitis* and *A. maranguapensis* are 2-2-3-3, whereas that of *A. pachydactyla* is like that of *A. adiastrata*. The phalangeal formulae for the feet of the three species in eastern Brazil is 2-2-3-4-3. In comparison with *A. adiastrata*, the number of carpals is reduced in *A. tridactyla*, which has one large distal carpal and two (? three) smaller proximal carpals. The great digital reduction in *A. tridactyla* suggests that this species might be placed in a different genus, but until sufficient material is available to make osteological preparations for adequate comparison, the species is placed in *Adelophryne*.

Adenomera hylaedactyla Cope

This small, terrestrial species was common in the study zones at SJ and NTL and in the floodplain forest at TL; nine of 21 specimens were taken in pitfall traps. Ten individuals were found at night; nine were active on the ground by day, and two were beneath cover by day. Six males have SVLs of 18.8-24.1 (\bar{x} = 21.1) and masses of 0.3-1.1 (\bar{x} = 0.72), and 13 females have SVLs of 23.3-27.8 (\bar{x} = 25.1); 10 gravid females have masses of 1.0-1.5 (\bar{x} = 1.17) and two spent females, 0.7 and 1.2. The smallest juvenile has a SVL of 7.2 and a mass of <0.1. In life, the dorsum varies from pale tan with brown spots to dull gray. The venter is creamy white. Of 21 specimens, 18 have a short, narrow, middorsal stripe posterior to the sacrum; one has a broad cream dorsolateral stripe, and four have dull red, granular dorsolateral stripes.

Heyer (1973; pers. comm.) distinguished *A. hylaedactyla* from *A. andreae* by the shape of the tips of the digits—rounded in section in *A. hylaedactyla* and flattened in *A. andreae*. Examination of specimens from throughout eastern Peru and Ecuador reveals both types of digital discs, but the discs of many individuals are intermediate in structure. The distinction between these two nominal species is not convincing, and the oldest available name is used here.

Ceratophrys cornuta (Linnaeus)

This terrestrial species is represented only by a large skull from TL. The skull (complete except for the premaxillae) has a width of 51.3. Using the statistics for head width and SVL relationships in this species given by Duellman and Lizana (1994), the present specimen must have had a SVL of about 135 mm.

Edalorhina perezii Jiménez de la Espada

Four individuals were collected in pitfall traps (two at SJ and two at NTL). Two adult males have SVLs of 31.6 and 31.7 and masses of 2.6 and 3.7, whereas two juveniles have SVLs of 23.5 and 26.3 and masses of 0.7 and 1.1. These four specimens have Type 2 dorsal skin texture and Type 2 ventral color pattern identified by Duellman and Morales

(1990); these patterns agree with their analysis of geographic variation in that all specimens from the drainages of the Río Pastaza and Río Napo have Type 2 ventral color pattern, whereas 8.9% of specimens from the Río Napo drainage and 54.5% of the specimens from the Río Pastaza drainage have Type 2 dorsal skin texture.

Eleutherodactylus acuminatus Shreve

One male having a SVL of 16.9 was on a leaf of a bush 1 m above ground at the edge of the forest at SJ.

Eleutherodactylus altamazonicus Barbour and Dunn

One subadult female having a SVL of 17.6 and a mass of 0.3 was on the leaf of an herb at night at TL. In life, the groin and hidden surfaces of the thighs were red with black markings.

Eleutherodactylus delius new species

Holotype.—URP-WED 59957, an adult female, from the study zone at San Jacinto, (02°18'44.8"S, 75°51'46.0"W, 183 m), Provincia Loreto, Departamento Loreto, Peru, obtained on 7 July 1993 by Alfonso Miranda.

Diagnosis.—Scheme following Lynch and Duellman (1980) for ease of comparison. A member of the *Eleutherodactylus unistrigatus* group as defined by Lynch and Duellman (1995) with the following combination of characters: (1) skin of dorsum smooth; skin of venter granular; (2) tympanic annulus and tympanic membrane distinct, diameter of annulus 40% diameter of eye, separated from eye by distance equal to diameter of tympanum; (3) snout acutely rounded in dorsal view, round in profile; canthus rostralis angular; (4) upper eyelid 73.7% of interorbital distance, lacking tubercles; cranial crests absent; (5) vomerine odontophores absent; (6) males unknown; (7) first finger shorter than second; toepads large, subtruncate; toepad on Finger III equal to length of tympanum; (8) fingers with lateral keels; (9) ulnar tubercles present; (10) tubercles on heel present; outer edge of tarsus tuberculate; inner edge of tarsus smooth; (11) two metatarsal tubercles; inner elliptical, five times size of round outer tubercle; supernumerary plantar tubercles absent; (12) toes with lateral keels; webbing absent; toepads smaller than those on fingers; Toe V much longer than Toe III; (13) dorsum tan with three longitudinal brown stripes; posterior surfaces of thighs brown; venter cream; (14) adult female 30.9 mm SVL.

Eleutherodactylus delius differs from all other Amazonian members of the genus by lacking vomerine odontophores and having a dorsal pattern consisting of dark brown longitudinal stripes on a tan ground color.

Description.— $n = 1 \text{ } \varnothing$. Head not wide as body, longer than wide; head width 39.8% of SVL; head length 42.7% of SVL; snout long, slightly protruding beyond margin of lip, acutely rounded in dorsal view, rounded in profile; eye-nostril distance 12.6% of SVL; upper eyelid lacking tubercles; eyelid width 73.7% of interorbital distance. Top of head flat; cranial crests absent; canthus rostralis straight, angular in section; loreal region noticeably concave; lip slightly

flared anterior to orbit; internarial area slightly depressed; nostril protuberant laterally, directed dorsolaterally at point slightly posterior to anterior margin of lower jaw. Supratympanic fold moderate, curving posteroventrally from posterior corner of orbit, obscuring posterodorsal part of tympanic annulus; tympanum round, distinct, separated from eye by distance equal to diameter of tympanic annulus, which is 40.5% of eye diameter. Choanae small, round, not obscured by palatal shelf of maxillary arch; vomerine odontophores absent. Tongue broadly elliptical, barely notched posteriorly, free behind for about 40% of its length.

Skin on dorsum of head, body, and limbs smooth with scattered minute pustules; dermal folds absent on dorsum; skin on flanks weakly granular; belly and ventral surfaces of thighs granular; other ventral surfaces smooth; discoidal fold present; ulnar tubercles low, largest distally; pair of small heel tubercles present; row of low tubercles on outer edge of tarsus. Cloacal opening puckered, directed posteroventrally at upper level of thighs.

Forearm slender; fingers moderately long with broad lateral keels and large, subtruncate discs; disc on Finger I distinctly smaller than those on other fingers; relative lengths of fingers $I < II < IV < III$; subarticular tubercles large, subconical; supernumerary tubercles absent; palmar tubercle bifid, elevated; thenar tubercle elliptical, elevated. Hind limbs moderately slender; heels broadly overlapping when hind limbs flexed at right angles to axis of body; tibia length 54.4% of SVL; foot length 46.0% of SVL. Thick tarsal fold on distal one third of tarsus; inner metatarsal tubercle large, elliptical; outer metatarsal tubercle small, round; toes moderately long, bearing lateral keels and subtruncate discs noticeably smaller than those on fingers; relative lengths of toes $I < II < III < V < IV$; Toe III extending to distal edge of penultimate subarticular tubercle on Toe IV; Toe V extending to point slightly distal to distal subarticular tubercle on Toe IV; subarticular tubercles large, subconical; supernumerary tubercles absent.

Color in preservative: Dorsum creamy tan with narrow, black canthal and supratympanic stripes; tympanum black; prominent dark brown bar extending anteroventrally from orbit to margin of upper lip, which otherwise bordered by brown spots. Broad dark brown middorsal (with narrow cream middorsal line) and dorso-lateral stripes extending from level of eyelids to posterior end of body; faint, narrower brown paravertebral stripes extending from snout to sacrum; faint brown transverse bars on limbs; 2 bars each on forearm, thigh, shank, and tarsus. Flanks cream with brown flecks anteriorly; anterior and posterior surfaces of thighs pale brown; cloacal region and outer edge of tarsus dark brown; venter cream with minute black flecks on throat, chest, and ventral surfaces of hind limbs.

Color in life: Dorsum yellowish tan with pale brown stripes on body and transverse bars on limbs; infracanthal region dark brown; tympanum and supratympanic and suborbital bar black; posterior surfaces of thighs brown; ventral surfaces of limbs lavender; belly creamy white; throat pale tan with cream spots; iris gold with median horizontal reddish brown streak (Pl. 1).

Measurements: SVL 30.9, tibia length 16.8, foot length 14.2, head width 12.3, head length 13.2, interorbital distance 3.8, upper eyelid width 2.8, eye-nostril 3.9, eye diameter 3.7, tympanum diameter 1.5, eye-tympanum 1.5.

Ecology.—The only known specimen, a gravid female with a mass of 2.1 was on leaf litter in primary forest at 0635 h.

Etymology.—The specific name is a noun in apposition and a patronym for Carlos Delius, President of Occidental Petroleum Company of Peru. His name is associated with this distinctive species in grateful appreciation for the ex-

tensive logistic support provided by his company.

Remarks.—The description of a new species of *Eleutherodactylus* based on a single specimen would be unthinkable to many herpetologists. However, this specimen is so distinctively different from any other Amazonian species that it is inconceivable that it is a variant of a known species.

Eleutherodactylus diadematus (Jiménez de la Espada)

This species was found in the study zones at SJ and NTL and in the floodplain forest at TL. Four were on vegetation 0.3–2.0 m above ground at night; three were on the forest floor—two at night and one by day. One adult male has a SVL of 32.5 and a mass of 1.9; one adult female has a SVL of 40.9 and a mass of 5.0, and a subadult female has a SVL of 31.6 and a mass of 1.2. Four juveniles have SVLs of 17.5–24.7 (\bar{x} = 20.6) and masses of 0.4–1.0 (\bar{x} = 0.65). All specimens have dark diagonal bars on the flanks. In life the dorsal ground color varies from dark brown to tan, and there seems to be ontogenetic change in coloration. For example, the coloration of a juvenile having a SVL of 17.5 was: Dorsum brown; heels orange; posterior surfaces of thighs brown; flanks with dark brown and pale green diagonal bars; groin pink; venter white mottled with gray; iris bronze above and gray below. In contrast, an adult female having a SVL of 40.9 mm was: Dorsum tan irregular brown spots; flanks cream with brown diagonal bars; groin and anterior surfaces of thighs black and yellow; posterior surfaces of thighs black; venter cream with dark brown mottling; iris reddish copper.

Eleutherodactylus lanthanites Lynch

In the study zone at SJ, two gravid females having SVLs of 39.3 and 38.9 and masses of 3.0 and 3.3 were on the forest floor at 0630 h, and a subadult female having a SVL of 23.5 and a mass of 0.6 g, was in a pitfall trap at 0700 h. Color notes on the subadult female in life are: Dorsum dark brown; venter creamy yellow; ventral surfaces of limbs orange; posterior surfaces of thighs dark brown; throat laterally orange-tan. In preservative, all specimens have a median cream stripe on a gray throat.

Eleutherodactylus luscombei new species

Holotype.—URP-WED 60412, an adult male from the study zone at 1.5 km N Teniente López, (02°35'39.6"S, 76°06'55.0"W, 312 m), Provincia Loreto, Departamento Loreto, Peru, obtained on 23 July 1993 by David M. Webb.

Referred specimens.—KU 222002, an adult female, from the type locality, KU 222004, an adult male, from the type locality, KU 222006, an adult male from Teniente López, URP-WED 59865 and URP-WED 60040 (juveniles) from San Jacinto, Departamento Loreto, Peru; KU 222003 and URP-WED 60413 (juveniles), KU 222005 (subadult male) from the type locality; URP-WED 60320 and KU 222007 (juveniles), URP-WED 60319 (subadult male) from Teniente López.

Diagnosis.—Scheme following Lynch and Duellman (1980) for ease of comparison. A member of the *Eleuthero-*

dactylus unistrigatus group as defined by Lynch and Duellman (1995) with the following combination of characters: (1) skin of dorsum shagreen with scattered pustules and W- or \-shaped dermal ridges in scapular region; skin of venter granular; (2) tympanic annulus and membrane distinct, diameter of annulus about one third diameter of eye, separated from eye by distance about equal to diameter of tympanum; (3) snout round in dorsal view and in profile; canthus rostralis acutely rounded; (4) width of upper eyelid 70–92% of interorbital distance; without tubercles; cranial crests absent; (5) vomerine odontophores prominent, dentigerous; males lacking vocal slits, vocal sac, and nuptial excrescences; (7) first finger shorter than second; toepads round; toepad on Finger III slightly smaller than diameter of tympanum; (8) fingers with lateral keels; (9) ulnar tubercles absent; (10) tubercles on heel absent; outer edge of tarsus smooth; inner edge of tarsus with row of low tubercles distally; (11) one metatarsal tubercle; inner tubercle large, elliptical; outer tubercle absent; supernumerary plantar tubercles small, round; (12) toes with lateral keels; webbing basal; toepads about equal in size to those on fingers; Toe V much longer than Toe III; (13) dorsum brown with top of head and snout (or only snout) cream or tan; posterior surfaces of thighs dark brown; venter cream, finely to heavily flecked with black; (14) adults small; 3 males 19.1–19.9 (\bar{x} = 19.5) SVL; 1 female 26.1 SVL.

In the middle and upper Amazon Basin there are 24 known species of the *Eleutherodactylus unistrigatus* group; these are species with granular skin on the venter and expanded toepads (Lynch, 1976). Of these, five (*E. aaptus*, *bearsei*, *diadematus*, *sulcatus*, and *ventrimarmoratus*) are much larger than *E. luscombei*; three others (*E. acuminatus*, *paululus*, and *pseudoacuminatus*) are green in life. Four species (*E. carvalhoi*, *croceoinguinis*, *toftae*, and *variabilis*) differ from *E. luscombei* by having large yellow or orange spots in the groin. Of the remaining species, *E. altamazonicus* and *E. imitatrix* differ by having tuberculate skin on the dorsum, *E. martiae* by having dorsolateral folds and a partially concealed tympanum, *E. orphnolaimus* by having tubercles on the eyelids and snout, and *E. quaquaversus* by having calcars and a concealed tympanum. Other species differ mainly in coloration—*E. lacrimosus* by having a pale dorsum with dark markings but no labial bars, *E. lythodes* by having a black dorsum and black and red venter, *E. zimmermanae* by lacking vomerine odontophores, and *E. delius* by lacking vomerine odontophores and having dark longitudinal stripes on a pale dorsum. The remaining two species are most similar to *E. luscombei*; *E. ockendeni* is slightly larger and lacks pale coloration on the snout and top of the head, whereas, *E. trachyblepharus* is smaller, has a partially concealed tympanum, lacks lateral keels on the digits and dermal folds on the dorsum (but may have W-shaped dark mark in scapular region), and has two metatarsal tubercles.

Description.— $n = 3 \sigma\sigma$, 1 σ . Head as wide as body, longer than wide; head width 38.7–39.8% (\bar{x} = 39.3) of SVL; head length 42.7–47.4% (\bar{x} = 44.9) of SVL; snout moderately long, barely protruding beyond margin of lip, round in dorsal view and in profile; eye-nostril distance 12.6–13.6% (\bar{x} = 13.1) of SVL; upper

eyelid smooth; width of upper eyelid 70.4–91.7% (\bar{x} = 83.0) of interorbital distance. Top of head flat; cranial crests absent; canthus rostralis shallowly curved, acutely rounded in section; loreal region noticeably concave; lip slightly flared anterior to orbit; internarial area barely depressed; nostril slightly protruding, directed laterally at point just behind level of anterior margin of lower jaw. Supratympanic fold diffuse, obscuring posterodorsal part of tympanic annulus; tympanum distinct, separated from eye by distance slightly less than diameter of tympanic membrane, which is 33.3–37.1% (\bar{x} = 35.8) diameter of eye. Choanae small, ovoid, not obscured by palatal shelf of maxillary arch; vomerine odontophores small, prominent, moderately separated medially, each bearing 2 or 3 teeth in males, 5 in female. Tongue cordiform, shallowly notched posteriorly, free behind for about 40% of its length; vocal slits and vocal sac absent.

Skin of dorsum of head, body, and limbs shagreen with W- or V-shaped dermal folds in scapular region followed posteriorly by pair of tubercles; skin on flanks shagreen; skin on belly and posteroventral surfaces of thighs coarsely granular; other ventral surfaces smooth; discoidal fold barely evident; ulnar tubercles absent; heel tubercles absent; no tubercles on outer edge of tarsus. Cloacal opening puckered, directed posteroventrally at upper level of thighs.

Forearm slender; fingers moderately short, bearing narrow lateral keels and round discs; disc on Finger I smaller than those on other fingers; relative lengths of fingers I < II < IV < III; subarticular tubercles moderately large, round, elevated; supernumerary tubercles small, round, only on proximal segments; palmar tubercle

bifid, elevated; thenar tubercle elliptical, slightly elevated; males lacking nuptial excrescences (Fig. 15). Hind limb moderately slender; heels broadly overlapping when hind limbs flexed at right angles to axis of body; tibia length 52.0–57.6% (\bar{x} = 54.9) of SVL; foot length 41.3–48.7% (\bar{x} = 46.1) of SVL. Row of three or four slightly elliptical tubercles on distal third of inner edge of tarsus; inner metatarsal tubercle elliptical; outer metatarsal tubercle absent; toes moderately long, bearing lateral keels and round discs subequal in size to those on Fingers II–IV; relative lengths of toes I < II < III < V < IV; Toe III extending to middle of penultimate subarticular tubercle on Toe IV; Toe V extending to middle of distal subarticular tubercle on Toe IV; basal webbing between all toes except first and second; subarticular tubercles small, round; supernumerary tubercles minute (Fig. 15).

Color in preservative: Dorsum dark brown with black dermal ridges and scapular tubercles, diffuse dark brown diagonal bar extending posteroventrally from sacrum onto flank, and dark brown bars on limbs—one broad bar on forearm and four narrow bars each on thigh, shank, and tarsus. Flanks brown with diffuse cream flecks; lips barred with dark brown. Anterior and posterior surfaces of thighs dark brown; heels creamy tan in two males; narrow cream supraclacal stripe in three males. Top of head and snout pale tan in KU 222006; only snout tan in KU 222002 and URP-WED 60412; top of head and snout not paler in KU 222004. Venter of body pale cream with brown flecks on throat and chests in males and more dense flecks over entire venter in female. Top of head and snout pale in three of eight juveniles; one juvenile with only snout pale.

Color in life: Dorsum dark brown with black tubercles in scapular region, darker brown transverse bars on limbs, and indistinct diagonal marks on flanks; posterior surfaces of thighs dark brown; venter dusky cream with or without brown flecks; upper lip tan or cream with dark brown bars; iris orange-copper. In those specimens having a pale snout and top of head, this area is creamy tan to pale reddish tan (Pl. 1).

Measurements: One female followed by range (mean in parentheses) of three males: SVL 26.1, 19.1–19.9 (19.5); tibia length 13.7, 10.2–11.4 (10.9); foot length 10.8, 9.2–9.5 (9.3); head length 11.5, 8.5–9.3 (8.8); head width 10.3, 7.5–7.8 (7.7); interorbital distance 3.0, 2.4–2.7 (2.5); eyelid width 2.7, 1.9–2.2 (2.0); eye-nostril distance 3.3, 2.5–2.7 (2.6); eye diameter 3.5, 2.8–3.0 (2.9); tympanum diameter 1.2, 1.0–1.1 (1.03), eye-tympanum distance 1.2, 0.9–1.0 (0.97).

Ecology.—All individuals were on leaves of herbs and bushes 0.1–1.0 m above the ground in primary forest at night.

Etymology.—The specific name is a patronym for B. Anthony (Tony) Luscombe, President, Asociación de Ecología y Conservación, Lima, Peru, in recognition of his many years of persistent efforts to integrate biological inventories and conservation programs in Peru. Not coincidentally, the clearly demarcated coloration of the top of the head of many specimens of this species is parallel to that of Tony Luscombe.

Remarks.—The one gravid female has a mass of 1.3, and three adult males have masses of 0.4–0.6 (\bar{x} = 0.5). The two smallest juveniles have SVLs of 9.0 and 10.4 and masses of < 0.1.

Eleutherodactylus malkini Lynch

One male was on a fallen palm frond 1 m above the ground at night and one juvenile was on the forest floor by



Fig. 15. Hand and foot of *Eleutherodactylus luscombei*, URP-WED 60412. Scale bar = 1 mm.

day in the study zone at NTL; all other specimens are from TL, where five were on roots 0.2–0.4 m above the ground at the edge of a stream at night, two were on the forest floor on the floodplain by day, and three were on low vegetation at the edge of the oxbow lake at night. Six adult males have SVLs of 27.5–33.7 (\bar{x} = 32.1) and masses of 2.0–2.5 (\bar{x} = 2.2); three adult females have SVLs of 39.9–47.9 (\bar{x} = 43.6) and masses of 4.9–7.4 (\bar{x} = 6.4). In living adults the dorsum is pale orange tan with small, dark brown spots, and the posterior surfaces of the thighs are black with greenish yellow flecks; the throat is white, and the rest of the venter is yellow. The iris is bronze with a median, horizontal red streak. These specimens match well the description of this species by Lynch (1980) and provide the first description of coloration in life.

Eleutherodactylus martiae Lynch

One female was on a leaf 0.5 m above the ground at night in the study zone at SJ; in the study zone at NTL one male and one female were on the forest floor by day, and one female and two males were on leaves of herbs 0.1–0.7 m above ground at night. Three males have SVLs of 12.7–15.0 (\bar{x} = 13.7) and masses of 0.1–0.3 (\bar{x} = 0.17); one female with minute ovarian eggs has a SVL of 15.9 and a mass of 0.3, whereas two gravid females have SVLs of 20.1 and 21.8 mm and masses of 0.5 and 0.7. Structurally these specimens compare favorably with paratypes from Santa Cecilia, Ecuador, except that vomerine odontophores are not evident in any of the present specimens. Most topotypic specimens have dense dark flecks on the venter, whereas four of the present specimens have only scattered flecks on the venter. In life, the dorsum is dark brown to reddish brown, and the flanks are tan with brown diagonal marks; the posterior surfaces of the thighs are dark brown to black, and the iris is bronze with a median, horizontal red streak. One male had a brown dorsum with pale green streaks and a dark gray venter with creamy white flecks.

Eleutherodactylus nigrovittatus Andersson

Six specimens are from the study zone at SJ (2 in pitfall traps by day, 2 on the forest floor by day and 2 by night) and two are from the study zone at NTL (forest floor by day). Four males have SVLs of 15.4–17.5 (\bar{x} = 16.6) and masses of 0.4–0.5 (0.47), and three females (2 gravid) have SVLs of 19.1–20.8 (\bar{x} = 19.8) and masses of 0.6–0.9 (\bar{x} = 0.73). All individuals have a black anal patch and black diagonal mark in the groin; the bars on the limbs are distinct, and in life the forearms are orange. Six individuals have a faint, narrow, middorsal line posterior to the sacrum.

Eleutherodactylus ockendeni (Boulenger)

Individuals were found in the study zones at SJ and NTL and in the floodplain forest at TL. A juvenile that was amid leaf litter by day, and a minute juvenile (SVL 8.7, mass <0.1) in a rotting log at night. One adult male (SVL 18.6, mass 0.5) and three gravid females were on leaves of bushes

0.2–2.0 m above the ground at night. The females have SVLs of 27.7–31.8 (\bar{x} = 29.8) and masses of 1.6–1.7 (\bar{x} = 1.63). In life the dorsum is tan at night and brown by day; the flanks are tan, and the posterior surfaces of the thighs are dark brown.

Eleutherodactylus peruvianus (Melin)

Both adults and juveniles were active on the forest floor by day and perched on low vegetation (up to 0.5 m) at night in the floodplain forest at TL and in the study zone at NTL. At NTL on 22 July, a male with a mass of 1.7 was in amplexus with a female having a mass of 5.8 on the forest floor at 0740 h. Six males have SVLs of 22.3–28.9 (\bar{x} = 26.4) and masses of 0.6–2.0 (\bar{x} = 1.5), and one gravid female has a SVL of 41.4 and a mass of 5.8. The smallest of eight juveniles has a SVL of 6.0 mm and a mass of < 0.1. In life the dorsum varies from uniform dull red to olive tan in small juveniles. In larger juveniles and in adults, the dorsum is reddish tan with brown chevrons extending laterally onto the flanks and crossbars on the limbs; the posterior surfaces of the thighs are dark brown with minute red flecks. The face mask and postorbital stripe are dark brown; the venter is creamy white with or without brown flecks on the chest. The iris is bronze with a median, horizontal red streak. The amplexant pair and one juvenile have a broad creamy white labial stripe that is continuous with the same color on the upper arm. In preservative, adults have a variable intensity of gray mottling on the throat. In one male the mottling is nearly black, and in one male and the adult female the mottling is dark and extends onto the anterior part of the belly.

Eleutherodactylus quaquaversus Lynch

Two subadult females (one from the floodplain forest at TL and one from the study zone at NTL) were on low vegetation at night. These have SVLs of 17.9 and 18.8 and masses of 0.2 and 0.5, respectively. In contrast to adults from Ecuador, the tubercle on the heel is barely evident, but the tubercles on the margin of the upper eyelid are present; furthermore, the venter is more heavily flecked with black than in Ecuadorian specimens. These specimens apparently are the first records from Peru. According to Lynch's (1980) review of Amazonian *Eleutherodactylus*, this species is known from elevations of 320–1830 m in the upper Amazon Basin and on the Amazonian slopes of the Andes in Ecuador; the closest record to the present localities is Cusuime, Provincia Morona-Santiago, Ecuador.

Eleutherodactylus sulcatus (Cope)

Two individuals are from the study zone at NTL. A juvenile having a SVL of 17.1 and a mass of 0.5 was on the forest floor by day. The dorsum was mottled brown and tan with grayish white markings—narrow middorsal line, heels, and diagonal bar below the orbit. The posterior surfaces of the thighs were black with a longitudinal white line; the belly was white with black flecks, and the iris was grayish

bronze with fine black reticulation. An adult female having a SVL of 44.5 and a mass of 10.0 was in a snap trap in the morning; the dorsum was dull tan, and the venter was cream.

Ichnocnema quixensis (Jiménez de la Espada)

Found in the study zones at SJ and NTL and in the floodplain forest at TL, most individuals were taken at night, but five were found by day. Four males have SVLs of 37.2–40.9 (\bar{x} = 38.9) and masses of 2.9–7.0 (\bar{x} = 5.4); nine gravid females have SVLs of 41.2–53.7 (\bar{x} = 48.2) and masses of 4.4–17.0 (\bar{x} = 10.7). The smallest of seven juveniles has a SVL of 16.9 and a mass of 0.2 g.

Leptodactylus pentadactylus (Laurenti)

A nongravid female having a SVL of 148.2 and a mass of 270 was at the side of a road at night at SJ, and two juveniles having SVLs of 61.8 and 66.9 and masses of 19.0 and 27.6 were in pitfall traps at 0650 h near the lagoon at SJ. Two other individuals are from the oxbow lake at TL, and another is from the forest pond at NTL. The first of these is a juvenile having a SVL of 79.7 and a mass of 43.0; the others are a juvenile having SVL of 47.3 and mass of 6.4 g, and a subadult male having a SVL of 102.9 and a mass of 126 g.

Leptodactylus rhodomystax Boulenger

Three juveniles found on the forest floor at night in the study zone at NTL have SVLs of 26.5–39.6 (\bar{x} = 33.6) and masses of 1.3–3.9 (\bar{x} = 2.9). In life, the dorsum and flanks are orange-tan with dark brown spots on the former; the hind limbs are black with cream yellow spots on the hidden surfaces of the thighs. The belly is orange-tan with creamy white spots, and the prominent labial stripe is pinkish white; the iris is dull red.

Leptodactylus wagneri (Peters)

This name is used in the restricted sense of Heyer (1994). Five individuals were at the margins of the forest pond at night at NTL, and one juvenile was at the edge of a small stream by day at NTL. One adult male with thumb spines has a SVL of 56.5 and mass of 18.8, and a subadult male has a SVL of 40.9 and mass of 7.0. One gravid female has a SVL of 77.5 and a mass of 58.0, and a subadult female has a SVL of 65 mm and a mass of 33.8. Two juveniles have SVLs 14.0 and 26.0 and masses of 0.1 and 1.6.

Lithodytes lineatus (Schneider)

Of the two specimens from NTL and 11 from SJ, all were on the forest floor by day or removed from pitfall traps by day, except two juveniles taken at night, one on the forest floor and one sleeping on a dead *Cecropia* leaf 0.1 m above the ground. Three adult males have SVLs of 33.1–37.5 (\bar{x} = 35.9) and masses of 2.9–4.9 (\bar{x} = 3.7); three gravid

females have SVLs of 43.8–47.2 (\bar{x} = 45.2) and masses of 3.4–6.2 (\bar{x} = 4.47), and two females with small ovarian eggs have SVLs of 37.7 and 39.8 and masses of 3.1 and 3.2, respectively. The three smallest juveniles have SVLs of 14.9–15.6 (\bar{x} = 15.3) and masses of 0.2–0.4 (\bar{x} = 0.3).

Physalaemus petersi (Jiménez de la Espada)

Of 64 individuals from the study zone at SJ, 52 were in pitfall traps at night or at dawn. On 30 June, three males were calling from the edge of lagoon at SJ, and 18 individuals were removed from pitfall traps within 10 m of the lagoon. One individual was removed from a pitfall trap in the study zone at NTL, and six were found in the floodplain forest at TL. Of all 71 specimens, seven were found on the forest floor by day and five at night; one of the latter was eating termites. Twelve adult males have SVLs of 21.0–24.4 (\bar{x} = 22.5) and masses of 0.7–1.2 (\bar{x} = 0.94); 15 adult females have SVLs of 26.0–30.4 (\bar{x} = 28.7) and masses of 1.4–3.3 (\bar{x} = 1.86). The two smallest juveniles were found on 1 and 4 July at SJ and have SVLs of 15.5 and 16.0 and masses of 0.3 each.

Vanzolinius discodactylus (Boulenger)

Three individuals are from TL and one from NTL; the latter and one of the former were on the forest floor by day. The others were at the edge of a temporary pond, a female by day and a calling male at night. The call is a series (usually 3) of whistle-like notes. An adult male has a SVL of 28.5 and a mass of 1.9, and an adult female has a SVL of 33.6 and a mass of 2.4; two juveniles have SVLs of 18.9 and 24.2 and masses of 0.7 and 1.3. In life, coloration of an adult male (KU 222100) was: Dorsum brown with dark brown markings; throat gray with black flecks; belly creamy white with gray flecks; tint of yellow in groin; iris bronze with black flecks.

MICROHYLIDAE

Chiasmocleis bassleri Dunn

Ten individuals fell into pitfall traps at night in the study zone at NTL. Four males have SVLs of 16.8–20.3 (\bar{x} = 18.7) and masses of 0.5–1.0 (\bar{x} = 0.75); six females with small ovarian eggs have SVLs of 19.5–21.6 (\bar{x} = 20.3) and masses of 0.7–1.0 (\bar{x} = 0.9). Coloration in life (KU 222103–05): Dorsum dull brown; canthal stripe prominent, cream; postorbital stripe creamy orange; forearm and stripe on anterior surface of hind limb pale orange; throat and chest gray with white flecks; belly and ventral surfaces of hind limbs white with pale bluish tint and large black spots; iris reddish bronze with minute black flecks. All individuals have a black inguinal spot, but they lack the indistinct pink spots on the flanks and anterior surfaces of the thighs in specimens from Santa Cecilia, Ecuador (Duellman, 1978).

Microhylidae incerta sedis

A single female (KU 222108) that was in a pitfall trap at 0950 on 20 July in the study zone at NTL does not fit into any of the genera of neotropical microhylids as characterized by Zweifel (1986) and modified by de Sá and Trueb (1991). A tympanum is present, and the occipital dermal fold is absent. There are three functional digits on the hand and four on the foot. In life, the dorsum was brown with minute cream flecks, the venter gray with white flecks, and the iris reddish bronze with black flecks (Pl. 1). Measurements: SVL 17.8, tibia length 7.5, foot length 7.1, head length 5.2, head width 5.5, diameter of eye 1.8, diameter of tympanum 0.8.

Radiographs revealed the existence of eight presacral vertebrae, coccygeal processes, small clavicles about one half length of coracoids, and quadratojugal separate from maxilla. The alary processes of the premaxillae seems to be inclined anteriorly, and there does not seem to be a notch in the shelf of the premaxillae. The skull appears to be completely roofed. The nature of the vomers and neopalatines could not be determined. The phalangeal formula for the hand is 1-2-3-2 and for the foot, ?-2-3-4-3 (first digit could not be determined); the terminal phalanges are pointed.

The only genera of New World microhylids having the occipital fold absent, clavicle reduced, and quadratojugal separate from maxilla (all derived character states according to Zweifel, 1986) are *Arcovomer*, *Chiasmocleis*, and *Syncope*. *Arcovomer* differs from the present specimen by lacking a tympanum and coccygeal processes and by having a normal phalangeal formula and T-shaped terminal phalanges. *Chiasmocleis* differs by lacking a tympanum and by having a normal phalangeal formula; however, some external digital reduction has been noted in occasional specimens of *Chiasmocleis* (Nelson, 1975).

Externally, the specimen resembles *Syncope*, but it is much larger than the two known species—SVL in *S. antenori* to 13.2 in females (Walker, 1973), to 11.7 in females of *S. carvalhoi* (Nelson, 1975). *Syncope antenori* has a tympanum, whereas *S. carvalhoi* does not. Externally, *S. antenori* has four fingers and four toes, and *S. carvalhoi* has three fingers and four toes. The phalangeal formula of *S. antenori* is 2-2-3-3 and 1-2-3-4-3; the phalangeal formula of *S. carvalhoi* is unknown. However, *Syncope* has only seven presacral vertebrae, as opposed to eight in the present specimen.

Thus, the present specimen exhibits characters of *Chiasmocleis* (eight presacral vertebrae) and *Syncope* (reduced phalangeal formula). Furthermore, it shares the presence of an external tympanum with *S. antenori*; the tympanum is absent in *Chiasmocleis* and *S. carvalhoi*. The specimen could be allocated to *Syncope* by amending the definition of that genus to include eight presacral vertebrae. The combination of states of *Chiasmocleis* and *Syncope* might justify the recognition of only one genus. However, no such taxonomic decisions should be forthcoming until more material is available on which to base a formal description of the species and to provide adequate osteological preparations so that some of the osteological characters can be verified.

RANIDAE

***Rana palmipes* Spix**

One adult was observed at the lagoon at SJ and two adult males having SVLs of 93.1 and 98.0, and masses of 79 each were on the shore of the oxbow lake at TL at night.

PLETHODONTIDAE

***Bolitoglossa peruviana* (Boulenger)**

Two females having SVLs of 31.2 and 36.4 were on leaves of bushes about 1.5 m above ground at the edge of the forest pond at NTL on the night of 20 July. At night the dorsum was pale tan; by day it was reddish brown with darker brown markings, and the venter was black. These specimens agree well with the definition of the species provided by Crump (1977), except that they have darker venters.

CAECILIIDAE

***Caecilia tentaculata* Linnaeus**

One female having a total length of 615 and 124 primary annuli was moving on the forest floor during a heavy rain at 2215 hr on 23 July in the study zone at NTL. Two other individuals, an adult and a juvenile, were observed on the same night.

GEKKONIDAE

***Gonatodes concinmatus* (O'Shaughnessy)**

One adult female having a length of 44 + 34 (tail tip apparently regenerated) and a mass of 2.0 was active on a fallen log at night at SJ. Color notes on female (KU 222138): dorsum tan and brown; throat bluish white with chocolate brown streaks; belly dull yellow with brown streaks.

***Gonatodes humeralis* (Guichenot)**

One juvenile having a length of 32 + 22 and mass of 0.15 was found on a wall of a building in camp at TL by day.

***Hemidactylus mabouia* (Moreau de Jonnés)**

An adult male having a length of 62 + 71 and a mass of 3.7 was on a building in camp at SJ by night and a juvenile having a length of 25 + 27 was on a building there by day. One juvenile having a length of 23 + 26 and a mass of 0.1 was inside a building at TL by day.

***Lepidoblepharus hoogmoedi* Avila-Pires**

Two gravid females each having SVLs of 27 and one with a complete tail length of 25 were collected on, and under, palm litter near the temporary pond at TL; their masses were 0.45 and 0.40, respectively. An adult male having a SVL of 26, an incomplete tail, and a mass of 0.3 was in a pitfall trap by day in the study zone at NTL. These specimens match

closely the description and photograph provided by Avila-Pires (1995) in details of both scutellation and coloration, with the exception that the lower postnasal is about equal in size to the upper postnasal in the male (KU 222143).

Color notes on the male (KU 222143), in life: chin pinkish tan with dark brown stripes. Color notes on same specimen taken from color transparency: limbs dark brown; dorsum dark brown with two longitudinal rows of ill-defined pale brown blotches; top of head dark brown with diffuse blue-gray W-shaped mark between and covering eyelids; snout pale brown with dark brown spots, demarcated by thin cream transverse bar; cream horseshoe-shaped collar extending from posterior margin of orbits over occiput; dorso-lateral pale brown stripes extending from occipital collar posteriorly onto anterior one fourth of tail; tail pale brown, distinctly paler than all other surfaces; all surfaces speckled with blue-gray scales, those on limbs forming discrete spots; those on tail forming diffuse stripe laterally on proximal part of tail; two cream postorbital bars extending from orbit onto throat; iris dull brown, unmarked.

In preservative, the throat of KU 222143 is cream with a complex series of bold transverse and longitudinal gray lines that extend laterally to become infralabial bars; the ventral scales are gray, becoming darker peripherally and the scales which comprise the escutcheon are white with dark edges. In preservative, the females (UPR-WED 60335, UPR-WED 60438) are uniform dark brown with cream throats that have bold, or indistinct, linear markings, respectively.

Dixon and Soini (1986) listed *Lepidoblepharus festae* as part of the herpetofauna of the Iquitos region. Their color notes for *L. festae* are similar to the pattern in the original description and that of specimens of *L. hoogmoedi* reported here, with the exception that their specimens from near Iquitos have additional dorsal and lateral lines. Inasmuch as Miyata (1985) questioned the applicability *L. festae* for populations in the Amazon basin and given that only five specimens have been reported (2 by Avila-Pires, 1995, plus the 3 reported herein), it is possible that when variation in *L. hoogmoedi* is more completely known, the population in the Iquitos region will be found to be referable to this species.

Pseudogonatodes guianensis Parker

One gravid female having a SVL of 26 was in a pitfall trap by day in the study zone at SJ. A gravid female having a SVL of 26 and a mass of 0.2 was in a pitfall trap in the study zone at NTL; each contained one egg.

Thecadactylus rapicauda (Houttuyn)

An adult female having a length of 111 + 65 was found on a palm trunk 1.5 m above the ground at night in the study zone at SJ. An adult male having a length of 103 + 66 and a mass of 26.0 was found on tree trunk at night in the study zone at NTL.

HOPLOCERCIDAE

Enyalioides cofanorum Duellman

One adult male having a length of 215 + 140 and a mass of 60 was sleeping (head up) on a small tree trunk at night in the study zone at SJ. Coloration in life of KU 222163 from color transparencies: Dorsum dull tan with irregular dark brown markings tending to form transverse bars; throat bluish gray; iris brown medially, orange-tan peripherally. This individual is somewhat duller in coloration than the type series from Santa Cecilia, Ecuador (Duellman, 1973b).

Enyalioides laticeps (Guichenot)

One adult female having a length of 135 + 236 and a mass of 85.0 was on a tree trunk 2 m above the ground by day in the study zone at SJ. A juvenile having a length of 80 + 127 and a mass of 17.5 was sleeping on the ground under a small herb at night in the study zone at NTL. Color notes on the adult female (KU 222164): dorsum green; chin greenish yellow; throat rust; venter creamy tan; iris cream. Color notes on the juvenile (URP-WED 60106): dorsum bright green with dark rusty brown markings; throat buff with rusty red streaks; rest of venter cream with rusty red flecks; iris dull reddish copper with cream ring peripherally.

POLYCHROTIDAE

Anolis bombiceps Cope

Two adult females having lengths of 58 + 108 and 68 + 117 are from the study zone at NTL; the former female had a mass of 3.9 and was sleeping on a leaf 0.5 m above the ground, and the latter was killed by ants in a pitfall at night. Two adult males from the study zone NTL having lengths of 54 + 100 and 60 + 118 and masses of 2.8 and 3.3, respectively, were sleeping on leaves at night 0.3–0.5 m above the ground. Color notes on female (KU 222145): lining of buccal cavity and dewlap dark blue.

The distribution of *Anolis bombiceps* is encompassed completely within the western part of the range of *A. nitens*. These two species seem to be ecological equivalents; both are terrestrial and seem to favor logs and low buttresses. Both species have been reported from Río Itaya (Vanzolini and Williams, 1970) and Centro Unión (Dixon and Soini, 1986) in Departamento Loreto, Peru. Lescure and Gasc (1986) erroneously reported *A. bombiceps* from Santa Cecilia, Ecuador, where *A. nitens* is common (Duellman, 1978).

Anolis fuscoauratus D'Orbigny

This species was relatively common in the study zones at SJ, and NTL, along the stream at TL, and in the floodplain forest at TL. Individuals were inactive on saplings and leaves 0.5–2.0 m above the ground at night. One individual was asleep at night on emergent vegetation in the forest swamp at SJ. Ten females have lengths of 42–48 (\bar{x} = 44.8) + 81–97 (\bar{x} = 86.1) and masses of 0.8–1.5 (\bar{x} = 1.2).

Six males have lengths of 38–48 (\bar{x} = 43.5) + 74–87 (\bar{x} = 82.5) and masses of 0.9–1.5 (\bar{x} = 1.1). Two juveniles have lengths of 34 + 67 and 25 + inc. and masses of 0.5 and 0.2, respectively. Color notes on male (KU 222149): dewlap dull rose with pale cream scales. Color notes on male (KU 622152): dewlap pinkish rose with cream scales. In alcohol, two adult females (KU 222155, URP-WED 60416) are dark brown dorsally with a broad copper dorsal stripe, extending from the occiput well onto the tail and bordered laterally by thin black stripes.

Unlike as in most anoles, the dewlap color seems to be highly variable. In specimens from Santa Cecilia, Ecuador, the dewlap is rose-pink with white scales (Duellman, 1978), whereas in the Iquitos region of Peru, the dewlap is pale lemon yellow to pale green (Dixon and Soini, 1986). According to Avila-Pires (1995) the dewlap has been reported as red in specimens from Manaus, Brazil, and gray in specimens from Benjamin Constant, Amazonas, Brazil. However, in all specimens the scales in the dewlap are white or pale cream.

In her review of the habits of this species, Avila-Pires (1995:63) noted that "...*A. fuscoauratus* is mainly found on vegetation, up to 2 m, in forest, occasionally also on the ground or higher up (at least up to 5 m)." She mentioned that Beebe (1944) reported two specimens in the top of a 90-foot tree within 15 minutes after it had been cut down and suggested "...that the species also may be present in the canopy." Beebe's report and Avila-Pires's suggestion have been corroborated by observations of many individuals of *A. fuscoauratus* on branches and limbs at heights of 30 m above the ground along the canopy walkway at the Amazon Center of Environmental Education and Research near the junction of the Río Sucusari and Río Napo, Departamento Loreto, Peru (WED, pers. obs.).

Anolis nitens (Wagler)

An adult male having a length of 74 + 155 was at the edge of the forest at SJ by day and an adult female having a length of 83 + 171 and a mass of 16.0 was sleeping on a branch 0.5 m above the ground at night at SJ. The male (KU 222147) emitted an audible squeak while it was being restrained for a photograph. Vocalization has been reported in several species of *Anolis* (Greene, 1988), but never has it been reported in this species.

Previously, populations of this taxon in Amazonian Ecuador and Peru have been known as *Anolis chrysolepis* (subspecies *scyphus*) (Duellman, 1978; Dixon and Soini, 1986). Avila-Pires (1995) placed all subspecies of *A. chrysolepis* as subspecies of *A. nitens*. Geographically separate populations of *Anolis chrysolepis* (= *nitens*) were studied by Vanzolini and Williams (1970), together with *A. bombiceps*, which is sympatric with *A. nitens* in Vaupés, Colombia, and Loreto, Peru; they regarded the separate populations as subspecies, but, as pointed out by Avila-Pires (1995), areas of intergradation are not known between some of these populations. Thus, the "subspecies" of *A. nitens* may be distinct species,

in which case the lizards in Amazonian Peru and Ecuador would be recognized as *Anolis scyphus* Cope.

Anolis trachyderma Cope

An adult male from the study zone at SJ having a length of 49 + 101 and a mass of 1.6 and an adult male from the study zone at NTL having a length of 54 + inc. and a mass of 2.3 were caught in a pitfall traps by day. A juvenile having a length of 31 + 55 and a mass of 0.2 was found on the forest floor by day in the study zone at NTL and a juvenile having a length of 34 + 60 and a mass of 0.9 was found climbing up the base of a stilt palm by day in the floodplain forest at TL. Color notes on a juvenile (URP-WED 60183): belly yellow; throat orange. All individuals have smooth ventral scales (*contra* Dixon and Soini, 1986).

Anolis transversalis Duméril

All individuals of this species were in the study zone or forest swamp at SJ. Two adult males having lengths of 77 + 150 and 76 + 142 and masses of 4.1 and 7.9, respectively were sleeping on horizontal vines 1.5–2.5 m above the ground at night. A juvenile having a length of 38 + 71 and a mass of 0.8 was in a pitfall trap by day and another juvenile having a length of 57 + 77 was sleeping on the tip of a vertical stem 2.5 m above the ground at night. Duellman (1978) and Dixon and Soini (1986) mentioned that this species typically seems to inhabit the high canopy level of large trees—perhaps only leaving these trees to lay eggs (Dixon and Soini, 1986). Our discovery of adult males and moderately -sized juveniles at heights of 1.5–2.5 m suggests that this species may be slightly more catholic in its choice of habitat. Color notes on a juvenile (KU 222161): iris blue; dewlap yellow-orange with dark brown markings; dorsum green with paler green and black diagonal markings. Color notes on an adult male (KU 222162): capable of changing from bright green with nearly black transverse markings to pale brown with less intense markings; iris blue.

TROPIDURIDAE

Tropidurus plica (Linnaeus)

An adult female having a length 122 + 146 (tail tip regenerated) and mass of 81.0 was on a tree trunk 5 m above the ground by day in the study zone at NTL.

Tropidurus umbra (Linnaeus)

All individuals were sleeping, head up or horizontally, on vegetation at night 0.5–5 m above the ground at night in the study zones at SJ and NTL, along the stream at TL, and in floodplain forest at TL, except one, which was in a pitfall by day in the study zone at SJ. Four adult males have lengths of 79–85 (\bar{x} = 83.3) + 186–190 (\bar{x} = 188.3) and masses of 15.1–18.5 (\bar{x} = 16.7). A juvenile has a length of

69 + 155 and mass of 8.7. An adult female has a length of 84 + 187 and a mass of 15.5.

GYNOPHTHALMIDAE

Alopoglossus atriventris Duellman

Two females having lengths of 51 + 67 and 49 + 7 were in the study zone at SJ. The former was found in the leaf litter by day and had a mass of 4.5. The latter was killed by ants in a pitfall trap, and mass was not measured. One individual (URP-WED 60056) has black on the lateral surfaces, whereas the other (KU 222167) has the lateral surfaces only slightly darker brown than the dorsum; females of this species typically have lateral surfaces the same color as the dorsum (Duellman 1973b). Both specimens have cream venters, as is typical for females of this species.

Alopoglossus buckleyi (O'Shaughnessy)

Two males having lengths of 47 + 79 and 43 + 69 and masses of 2.4 and 1.8, respectively, were on the forest floor by day in the study zone at NTL.

Alopoglossus copii Boulenger

An adult male having a length of 58 + 103 and a mass of 6.0 was active at night in leaf litter immersed at the edge of the forest pond at NTL. It is possible that the lizard was sleeping and disturbed by footsteps. Color notes on adult male (KU 222169): top of head reddish brown; dorsum dull brownish black; venter creamy tan (Fig. 16). This species is known from only a few other specimens from the Amazonian slopes of the Andes in Ecuador (Ruibal, 1952; Peters and Orejas-Miranda, 1986) (but see below). The specimen reported here has the following scale counts (format following Ruibal, 1952): midbody 18; transverse dorsal rows 23; transverse ventral rows 19; gulars 8. There are 16/16 femoral pores, the two most median pores are preanal in position. The color pattern on this specimen matches closely that described by Ruibal (1952), except that a few ventral scales lack brown flecking on the anterior portion of the scale.



Fig. 16. *Alopoglossus copii*, KU 222169, adult male, 58 mm SVL.

Vanzolini (1986) listed *A. copii* as a synonym of *Leposoma southi* (fide Uzzell and Barry, 1971). In fact, Uzzell and Barry (1971) did not synonymize these two taxa; rather they referred two specimens reported as *A. copii* by Boulenger (1913) to *L. southi*. Lescure and Gasc (1986) reported *A. copii* from Colonia, Departamento Loreto, Peru. However, it is not clear that their specimens have been identified correctly, inasmuch as they also listed material reported as *A. copii* from Santa Cecilia, Ecuador, by Duellman (1978). All specimens of "*A. copii*" from Santa Cecilia subsequently have been identified as *A. angulatus* by T. C. S. Avila-Pires.

Arthrosaura reticulata (O'Shaughnessy)

One adult male having a length of 47 + 60 and a mass of 2.3 was in a pitfall trap by day in the study zone at SJ. A juvenile having a length of 23 + inc. and mass of 0.1 was in leaf litter by day in the study zone at NTL and another juvenile having a length of 31 + inc. and a mass of 0.4 was in leaf litter at night near the temporary pond at TL. Color notes on adult male (KU 222170): venter orange-buff.

Leposoma parietale (Cope)

This species was relatively common in the study zones at SJ and NTL; none was observed in the floodplain forest at TL. Most were in pitfall traps by day; a few were in leaf litter by day, and one was on floating leaves at night at the edge of the forest swamp at SJ. Three adult males had lengths of 32–37 (\bar{x} = 34.6), all with incomplete tails, and masses of 0.6–0.8 (\bar{x} = 0.7). Five adult females with complete tails had lengths of 34–38 (\bar{x} = 36.2) + 41–54 (\bar{x} = 49.8) and masses of 0.3–0.9 (\bar{x} = 0.65); one female with an incomplete tail had a SVL of 44 and a mass of 1.5. Color notes on an adult female (KU 222174): venter dull cream.

Neusticurus ecleopus Cope

One adult male having a length of 50 + 80 drowned in a flooded pitfall trap at the edge of the lagoon at night in the study zone at SJ. An adult female having a length of 47 + 69 and a mass of 2.2 was active on floating leaves at the edge of a small *Heliconia* swamp at night in the study zone at NTL. Two juveniles having lengths of 27 + 20 (tail regenerating) and 24 + 32 and masses of 0.3 and 0.1, respectively, were in leaf litter and along a stream by day in the study zone at NTL. In alcohol, one juvenile (URP-WED 60101) has a white venter and the other juvenile (KU 222179) has a black venter. The dorsum of juveniles is pale tan; this color extends onto the tail. The dorsum of adults is uniform dark brown.

Prionodactylus oshaughnessyi Boulenger

Two adult males having lengths of 39 + inc. and 40 + 93 are from the study zone at SJ; one was in leaf litter by day and the other on a log 0.2 m above the ground by day. A juvenile having a length of 21 + inc. and a mass of 0.3 was crawling up a sapling 1.5 m above the ground by day in the

study zone at SJ. A juvenile having a length of 24 + 46 was on the forest floor by day in the study zone at NTL. Color notes on a juvenile (URP-WED 59883): tail red. These specimens match closely the diagnosis for this species given by Avila-Pires (1995), but we concur with her comment that the status of this species with respect to *P. argulus* (Peters) needs further attention.

SCINCIDAE

Mabuya nigropunctata (Spix)

Two juveniles having lengths of 132 + 39 and 50 + inc. and masses of 2.6 and 0.5 were on the ground in the camp at TL by day. These specimens match closely Avila-Pires's (1995) account for the species, which she recognized as separate from *M. bistrata* (Spix). However, the pale stripes bordering the dark lateral bands are more prominent than she presented as typical for the species. Also, these specimens lack keels on the scales, as seems to be characteristic of *M. nigropunctata* from western Amazonia, but these specimens are juveniles, and such ornamentation simply may not have developed. Color notes on juvenile (URP-WED 60102): head and dorsolateral stripes pale bronze-yellow; tail brown. According to Avila-Pires (1995), the tail is blue in this species.

TEIIDAE

Kentropyx pelviceps Cope

This species was relatively common; individuals were observed at SJ, NTL, and all areas near TL. Most were on the forest floor by day, but one was sleeping on a leaf 0.5 m above the ground at night. Five adult females had lengths of 92–117 (\bar{x} = 104.4) + 94–236 (\bar{x} = 160.8) and masses of 22–37.6 (\bar{x} = 28.7). Five adult males had lengths of 100–116 (\bar{x} = 106.4) + 150–259 (\bar{x} = 197.7) and masses of 27.5–46 (\bar{x} = 32.9). Two juveniles had lengths of 60 + 137 and 75 + 155; the former had a mass of 8.0.

Tupinambis teguixin (Linnaeus)

One male having a length of 202 + 395 and a mass of 250 was in a clearing created by a treefall at SJ. Another individual was observed in the forest at NTL.

AMPHISBAENIDAE

Amphisbaena fuliginosa Linnaeus

Two females having lengths of 286 + 45 and 322 + 49 and masses of 17.1 and 21.5, respectively, were crawling across a road and through grass in camp by day at SJ.

BOIDAE

Corallus enydris (Linnaeus)

This species was encountered only around the margin of

the swamp at SJ. An adult female has a length of 1510 + 366, a mass of 650, 285 ventrals, and 122 subcaudals. An adult male has length of 1280 + 292, a mass of 375, 284 ventrals, and 112 subcaudals. Two juveniles have lengths of 591 + 142 and 509 + 120 and masses of 32.5 and 20.1, respectively; each has 284 ventrals, and they have 119 and 117 subcaudals, respectively. Both adults were in hunting postures on vines 0.4–0.5 m above the ground at night. One juvenile was crawling across a road at night. Color notes on juvenile (KU 222190): dorsum grayish-brown with faint blotches; venter salmon; iris cream.

COLUBRIDAE

Chironius scurrulus (Wagler)

An adult female with a length of 1690 + 740, a mass of 1334, 157 ventrals, and 108 subcaudals was sleeping at night in small tree 1.5 m above the water at the edge of the swamp at SJ. Dissection revealed no food items or developing ova, but the body cavity contained many nematodes. Color notes (KU 222192): dorsum reddish brown; belly dull salmon with yellowish tint on chin; iris dark brown.

Dipsas catesbyi (Santzen)

An adult female containing four well-developed eggs and having a length of 550 + 203, a mass of 36.6, 186 ventrals, and 100 subcaudals was crawling on the ground at night in the study zone at SJ. An adult male having a length of 470 + 184, a mass of 15.5, 192 ventrals, and 104 subcaudals was crawling up a sapling 0.3 m above the ground at night in the study zone at NTL.

Drymarchon corais (Boie)

A large adult (length \pm 2.5 m) was observed moving rapidly across the forest floor by day in the study zone at SJ.

Imantodes cenchoa (Linnaeus)

Eight individuals were collected in the study zones at SJ and NTL, the swamp at SJ, and the floodplain forest at TL. Four males have lengths of 744–798 (\bar{x} = 779) + 322–365 (\bar{x} = 339). Males have 263–285 (\bar{x} = 273) ventrals and 162–180 (\bar{x} = 169) subcaudals. Two adult females have lengths of 705 + 284 and 776 + 321, 259 and 267 ventrals, incomplete and 160 subcaudals, and masses of 21.5 and 24.0, respectively. One female contains two well-developed eggs. Of two juveniles, one was alive and the other smashed on a trail. With the exception of the latter, all were active on vegetation 0.3–3.0 m above the ground at night. Two adults each contained two *Anolis fuscoauratus* in their stomachs and one contained one *A. fuscoauratus*.

Imantodes lentiferus (Cope)

One adult male having a length of 641 + 289, 235 ventrals, and 142 subcaudals was coiled in a tree by day at SJ.

A gravid female having a length of 645 + 285, a mass of 15.5, 231 ventrals, and 147 subcaudals was active on vegetation at night in the study zone at NTL; this snake contained two well-developed eggs.

Leptodeira annulata (Linnaeus)

Two adult males having lengths of 404 + 149 and 514 + 187 (mass of latter male: 29.5) were active at night on vegetation along the edge of lagoon at SJ while frogs were chorusing. These individuals have 189 ventrals and 93–94 subcaudals. One individual contained two nearly digested, unidentified frogs in the digestive tract.

Oxyrhopus petola (Reuss)

One adult male having a length of 674 + 178, a mass of 22.0, 217 ventrals, and 123 subcaudals was found in the study zone at NTL. Another adult male having a length of 649 + 246, a mass of 64.0, 215 ventrals, and 123 subcaudals was at the forest pond at NTL. An adult female having a length of 835 + 253, a mass of 122.0, 213 ventrals, and 100 subcaudals was in the floodplain forest at TL. The dorsum of the former male is black with bands; all bands are immaculate red except the three anteriormost bands, which are white. In the latter male all pale bands are immaculate red (Fig. 17). The female has a black dorsum with red bands that are heavily flecked with black. All specimens have 14 bands on the body that are narrower than the black interspaces. The venters of all three specimens are cream. All individuals were active on vegetation 0.5–3.5 m above the ground at night.



Fig. 17. *Oxyrhopus petola*, KU 222200, adult male, 649 mm SVL. Note that the nape band is the same color as the pale bands on the body.

Taeniophallus brevirostris (Peters)

We follow Myers and Cadle's (1994) assignment of *Echinanthera* (= *Rhadinaea*) *brevirostris* to the genus *Taeniophallus* Cope. One adult male having a length of 282 + 83, a mass of 12.6, 162 ventrals, and 64 subcaudals was active on the forest floor by day in the study zone at NTL. Color notes (KU 222203): throat, anterior part of venter lemon-yellow, rest of venter white.

Umbrivaga pygmaea (Cope)

One female having a length of 192 + 42 was dead on a dirt road in the morning at SJ. This specimen has 126 ventrals and 32 subcaudals.

Xenopholis scalaris (Wucherer)

Two adult females having lengths of 295 + 47 and 278 + 55, masses of 11.5 and 11.0, 144 and 143 ventrals, and 31 and 37 subcaudals, respectively, are from the study zone at NTL; the latter contains two well-developed eggs. Both individuals were active on the forest floor at night, and each displayed conspicuous body-flattening behavior when handled (Fig. 18).

ELAPIDAE

Micruurus spixii (Jan)

One adult male having a length of 1210 + 58, a mass of 530.0, 109 ventrals, and 17 subcaudals was active on the forest floor by day in the study zone at NTL.

VIPERIDAE

Bothrops atrox (Linnaeus)

A juvenile having a length of 392 + 69, a mass of 25.4, 196 ventrals, and 70 subcaudals, and an adult male having a length of 1060 + 182, a mass of 360.0, 202 ventrals, and 71 subcaudals are from the study zone at SJ. The juvenile was active on the forest floor at the edge of the lagoon at night and contained the remains of an unidentifiable frog in the digestive tract. The adult was on the forest floor by day; it contained the remains of a small, unidentifiable rodent in the digestive tract. A juvenile having a length of 400 + 58, a mass of 28.0, 206 ventrals, and 64 subcaudals was coiled on a fallen palm frond at the edge of the forest pond at NTL at night.

Bothrops brazili Hoge

A juvenile having a length of 394 + 62, a mass of 34.0, 177 ventrals, and 59 subcaudals was crawling on the forest floor by day in the study zone at NTL. This individual has 19 dark gray C-shaped marks on either side of the dorsum of the body; many are staggered on either side and do not meet at the midline. Distinct pale brown postocular stripes are

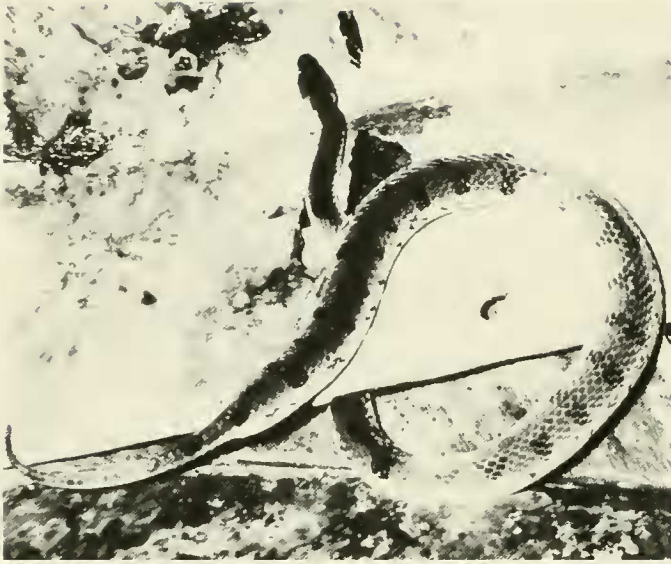


Fig. 18. *Xenopholis scalaris*, KU 222204, adult female, 295 mm SVL. Note that the posterior two thirds of the body is flattened.

present, and they are not bordered below by a dark stripe. In alcohol, the tip of the tail is pale; color in life was not recorded.

Porthidium hyoprora (Amaral)

An adult female having a length of $710 + 120$, a mass of 500.0, 130 ventrals, and 48 subcaudals was coiled between the buttresses of a large tree at night in the study zone at SJ; it contained rodent hairs in the lower intestine. The subcaudal scales on this individual are single, except the distal three, which are paired. Color notes (KU 222208): dorsum grayish brown with reddish brown blotches dorsally and chocolate brown spots laterally; canthal stripe reddish brown; postorbital stripe dark brown; venter grayish tan with cream spots. During capture and subsequent handling this individual remained calm and sluggish; neither gaping nor tail vibrating behaviors were observed. A male having a length of $285 + 62$, a mass of 26.0, 125 ventrals, and 49 subcaudals was crawling on the forest floor at night during a moderate rain in the study zone at NTL. The male has much greater contrast between the pale and dark areas on the dorsum than does the female (Fig. 19). Color notes on the male (KU 222209): dorsum tan with chocolate brown blotches becoming black on tail; venter predominately black with cream and rusty red spots; throat reddish brown with yellow spots. The male was much more aggressive during handling than the female; it struck repeatedly and vibrated the tail rapidly; gaping behavior was not observed. The size difference between these two adults is striking; the smaller male apparently is an adult (based on the large everted hemipenes). Campbell and Lamar (1989) noted that this species typically is found near water; however, both



Fig. 19. *Porthidium hyoprora*: Top—KU 222209, adult male, 285 mm SVL. Bottom—KU 222208, adult female, 710 mm SVL. Note near absence of pattern on anterior part of body of female.

of these specimens were in elevated, well-drained areas some distance (> 100 m) from flowing or standing water.

CHELIDAE

Phrynops gibbus (Schweigger)

One adult female was observed on the road near SJ. This individual had a small hole drilled near the edge of its carapace and may have originated from another area, having been brought in as a pet.

Platemys platycephala (Schneider)

One adult male was observed near the edge of the SJ lagoon.

PELOMEDUSIDAE

Podocnemis unifilis Troschel

Three juveniles were brought into camp at SJ by a local inhabitant who had caught them about 3 km to the south, in the Río Tigre. This species was abundant in the oxbow lake at TL, where many large adults were observed.

ALLIGATORIDAE

Caiman crocodilus (Linnaeus)

This species apparently was common—several individuals seen nightly—in the SJ lagoon and the SJ swamp. The largest individual observed had a total length of about 2.5 m. This species was not observed in any of the bodies of water around TL.

CROCODYLIDAE

Paleosuchus palpebrosus (Cuvier)

One juvenile having a length of 257 + 203 and a mass of 300 was sitting on the muddy bottom of a clear pool in a small forest stream at NTL at night. Color notes based on color transparencies: Dorsum of body and tail orange-tan with dark brown transverse bars (ill-defined on body); limbs and flanks dull brown with individual cream scales on flanks, especially noticeable at insertion of forelimbs; top of snout between nostrils and eyes, occiput, and temporal region brownish black; venter cream with small brown spots laterally on posterior part of belly and rust edges to scales on throat; iris dull bronze-brown with minute brown flecks; sclera of eye pale blue.

BIOGEOGRAPHY

Despite the incomplete nature of the collections from San Jacinto and Teniente López, they reveal some interesting aspects about the herpetofauna in the upper Amazon Basin. Herein we provide general comments on the herpetofauna, comparisons of the three localities (grouped sites at SJ, TL, and NTL), comparisons of the study zones at SJ and NTL, and comparisons with other regions in the upper and central Amazon Basin. Most of the emphasis is placed on data on anurans and lizards, collections of which are far more extensive than of other groups. Snakes are notoriously difficult to sample in lowland tropical rainforest; we obtained only 15 species, but at least 50 species are to be expected in the region. No effort was made to sample aquatic habitats; thus, our data on turtles, aquatic snakes, and crocodylians are sparse. The diel activity, microhabitats, and sites of occurrence of 113 species are given in Table 1.

COMPARISONS AMONG SITES

Curves of species-discovery rates indicate that the faunas at SJ and NTL were sampled evenly. Seventy-five species were

obtained in 36 person-days at the former and 75 species in 30 person-days at the latter (Fig. 20). Only 43 species were obtained at TL, where collecting effort was less (24 person days) and no drift fences and pitfall traps were used. Comparisons of the species-discovery rates at SJ and NTL with those at Santa Cecilia, Ecuador, where 173 (updated to 177) species were reported by Duellman (1978), and Cuzco Amazónico, Peru, where 145 species are known (Duellman and Koechlin, 1991), suggest that we obtained about 50% of the herpetofauna at SJ and TL. Our discovery of only 15 species of snakes, in contrast to 51 and 47 species at Santa Cecilia and Cuzco Amazónico, respectively, indicates that the principal group that is under-represented in collections from northern Loreto is snakes.

Comparisons of the herpetofaunas at the three sites were made using the coefficient of biogeographic resemblance of $2C / (N_1 + N_2)$, where C = the number of species in common and N_1 and N_2 = the number of species at sites one and two, respectively (Duellman, 1990). This analysis reveals that there is greater similarity in the entire herpetofaunas, anurans only, and lizards only between SJ and NTL (40 km apart) than between TL and NTL (1.5 km apart) (Table 2). The similarities between SJ and NTL are highest among lizards (CBR = 0.67). Among anurans, TL shows a closer resemblance to SJ (CBR = 0.52) than NTL (CBR = 0.44), whereas, SJ and NTL are more nearly alike (CBR = 0.58). The discrepancies in anurans among sites most likely reflect differences in available breeding sites. The presence of the black-water lagoon at SJ and the oxbow lake at TL provided breeding sites for species such as *Hyla calcarata* and *Rana palmipes*, whereas suitable breeding sites for these species were absent at NTL. The floodplain at TL was the only place where *Colostethus trilineatus* and *Dendrophryniscus minutus* were found; these species seemed to shun the hilly regions at SJ and NTL.

Inexplicably, some species not dependent on specific breeding sites were abundant at one site and absent at others. For example, among the species in the *Eleutherodactylus conspicillatus* group, *E. lanthanites* was present only at SJ, whereas *E. peruvianus* and *E. malkini* were present at TL and NTL. Among lizards of the *Anolis nitens* group, *A. nitens* was present only at SJ and *A. bombiceps* only at NTL.

Nineteen species (12 anurans, 6 lizards, and 1 snake) are common to all three sites. Thus, of 114 species, only 16.7% were found at all three sites; these include 18.2% of the anurans, 25.0% of the lizards, and 6.7% of the snakes. Again, the data on snakes are insufficient to be meaningful.

The patchiness of habitats in the lowland tropical rainforest is exemplified by data from SJ and NTL. At the latter site, the forest pond is only about 150 m west of the study zone, in which no pond existed; 16 species, 13 of which are anurans, were found at the forest pond but not in the study zone. Likewise, at the swamp about 1.5 km SSW of the study zone at SJ, five species were found that were not collected or observed in the study zone. It is evident that small patches of appropriate habitat, especially breeding sites for anurans, are widely scattered in the forest; such small patches

Table 1. (cont.)

SPECIES	DIEL ACTIVITY	MICRO- HABITAT	SAN JACINTO				TENIENTE LOPEZ				
			SZ	LA	SW	CA	SZ	FP	FL	ST	CA
<i>Eleutherodactylus diadematus</i>	N	B	+	-	-	-	+	-	+	-	-
<i>Eleutherodactylus lanthanites</i>	N	B	+	-	-	-	-	-	-	-	-
<i>Eleutherodactylus luscombei</i>	N	B	+	-	-	-	+	-	+	-	-
<i>Eleutherodactylus malkini</i>	N	B	-	-	-	-	+	-	+	+	-
<i>Eleutherodactylus martiae</i>	N	B	+	-	-	-	+	-	-	-	-
<i>Eleutherodactylus nigrovittatus</i>	DS	LL	+	-	-	-	+	-	-	-	-
<i>Eleutherodactylus ockendeni</i>	N	B	+	-	-	-	+	-	+	-	-
<i>Eleutherodactylus peruvianus</i>	DS, N	B, G	-	-	-	-	+	-	+	-	-
<i>Eleutherodactylus quaquaversus</i>	N	B	-	-	-	-	+	-	+	-	-
<i>Eleutherodactylus sulcatus</i>	N	G	-	-	-	-	+	-	-	-	-
<i>Ischnocnema quixensis</i>	N	G	+	-	-	-	+	-	+	-	-
<i>Leptodactylus pentadactylus</i>	N	G	+	+	-	+	-	+	+	-	-
<i>Leptodactylus rhodomystax</i>	N	G	-	-	-	-	+	-	-	-	-
<i>Leptodactylus wagneri</i>	N	G	-	-	-	+	+	+	-	-	-
<i>Lithodytes lineatus</i>	N	G	+	-	-	-	+	-	-	-	-
<i>Physalaemus petersi</i>	N	G	+	+	-	-	+	-	+	-	-
<i>Vanzolinius discodactylus</i>	N	G	-	-	-	-	+	-	+	-	-
Anura: Microhylidae:											
<i>Chiasmocleis bassleri</i>	N	G	-	-	-	-	+	-	-	-	-
Microhylidae sp.	N	G	-	-	-	-	+	-	-	-	-
Anura: Ranidae:											
<i>Rana palmipes</i>	N	AM	-	+	-	-	-	-	+	-	-
Caudata: Plethodontidae:											
<i>Bolitoglossa peruviana</i>	N	B	-	-	-	-	-	+	-	-	-
Gymnophiona: Caeciliidae:											
<i>Caecilia tentaculata</i>	N	F	-	-	-	-	+	-	-	-	-
Sauria: Gekkonidae:											
<i>Gonatodes concinmatus</i>	DS	TT	+	-	-	-	-	-	-	-	-
<i>Gonatodes humeralis</i>	DS	E	-	-	-	-	-	-	-	-	+
<i>Lepidoblepharus hoogmoedi</i>	DS	LL	-	-	-	-	+	-	+	-	-
<i>Pseudogonatodes guinanesis</i>	DS	LL	+	-	-	-	+	-	-	-	-
<i>Thecadactylus rapicauda</i>	N	TT	+	-	-	-	+	-	-	-	-
Sauria: Hoplocercidae:											
<i>Enyalioides cofanorum</i>	DH	TT	+	-	-	-	-	-	-	-	-
<i>Enyalioides laticeps</i>	DH	TT	+	-	-	-	+	-	-	-	-
Sauria: Polychrotidae:											
<i>Anolis bombiceps</i>	DH	G	-	-	-	-	+	-	-	-	-
<i>Anolis fuscoauratus</i>	DS	B, TL	+	-	-	-	+	-	+	+	-
<i>Anolis nitens</i>	DH	G	+	-	-	+	-	-	-	-	-
<i>Anolis trachyderma</i>	DS	B	+	-	-	-	+	-	+	-	-
<i>Anolis transversalis</i>	DH	TL	+	-	+	-	-	-	-	-	-
Sauria: Tropiduridae:											
<i>Tropidurus plica</i>	DH	TT	-	-	-	-	+	-	-	-	-
<i>Tropidurus umbra</i>	DH	TT	+	-	-	-	+	-	+	+	-
Sauria: Gymnophthalmidae:											
<i>Alopoglossus atriventris</i>	DS	LL	+	-	-	-	-	-	-	-	-
<i>Alopoglossus buckleyi</i>	DS	LL	-	-	-	-	+	-	-	-	-
<i>Alopoglossus copii</i>	DS	LL	-	-	-	-	-	+	-	-	-
<i>Arthrosaura reticulata</i>	DS	LL	+	-	-	-	+	-	+	-	-
<i>Leposoma parietale</i>	DS	LL	+	-	-	-	+	-	-	-	-
<i>Neusticurus eupleopus</i>	DS	AM	+	-	-	-	+	-	-	-	-
<i>Prionodactylus oshaugnessyi</i>	DH	G	+	-	-	-	+	-	-	-	-
Sauria: Scincidae:											
<i>Mabuya nigropunctata</i>	DH	G	-	-	-	-	-	-	-	-	+
Sauria: Teiidae:											
<i>Kentropyx pelviceps</i>	DH	G	+	-	-	+	+	+	+	+	+

Table 1. (cont.)

SPECIES	DIEL	MICRO-	SAN JACINTO				TENIENTE LOPEZ				
	ACTIVITY	HABITAT	SZ	LA	SW	CA	SZ	FP	FL	ST	CA
<i>Tupinambis teguixin</i> Amphisbaenia: Amphisbaenidae:	DH	G	-	-	-	+	+	-	-	-	-
<i>Amphisbaena fuliginosa</i> Serpentes: Boidae:	DS	F	-	-	-	+	-	-	-	-	-
<i>Corallus enydris</i> Serpentes: Colubridae:	N	TL	-	-	+	-	-	-	-	-	-
<i>Chironius scurrulus</i>	DH	B, G	-	-	+	-	-	-	-	-	-
<i>Dipsas catesbyi</i>	N	B, TL	+	-	-	-	+	-	-	-	-
<i>Drymarchon corais</i>	DH	G	+	-	-	-	-	-	-	-	-
<i>Imantodes cenchoa</i>	N	B, TL	+	-	+	-	+	-	+	-	-
<i>Imantodes lentiferus</i>	N	B, TL	+	-	-	-	+	-	-	-	-
<i>Leptodeira annulata</i>	N	B, TL	+	+	-	-	-	-	-	-	-
<i>Oxyrhopus petola</i>	N	G, B	-	-	-	-	+	+	+	-	-
<i>Taeniophallus brevivirostris</i>	DH	G	-	-	-	-	+	-	-	-	-
<i>Umbrivaga pygmaea</i>	?	G	-	-	-	+	-	-	-	-	-
<i>Xenopholis scalaris</i> Serpentes: Elapidae:	N	G	-	-	-	-	+	-	-	-	-
<i>Micruirus spixii</i> Serpentes: Viperidae:	DS	G	-	-	-	-	+	-	-	-	-
<i>Bothrops atrox</i>	DH, N	G, B	+	-	-	-	-	+	-	-	-
<i>Bothrops brazili</i>	DS	G	-	-	-	-	+	-	-	-	-
<i>Porthidium hyoprora</i> Testudines: Chelidae:	N	G	+	-	-	-	+	-	-	-	-
<i>Phrynops gibbus</i>	D	A	-	-	-	+	-	-	-	-	-
<i>Platemys platycephala</i> Testudines: Pelomedusidae:	D	A	-	-	-	+	-	-	-	-	-
<i>Podocnemis unifilis</i> Crocodylia: Alligatoridae:	D	A	-	-	-	+ ¹	-	-	-	-	-
<i>Caiman crocodilus</i> Crocodylia: Crocodylidae:	N	A	-	+	-	-	-	-	-	-	-
<i>Paleosuchus palpebrosus</i>	N	A	-	-	-	-	+	-	-	-	-
Total Species:			55	12	10	16	63	22	33	8	6

¹ Río Tigre.

are easily overlooked in quick surveys of the herpetofauna. Thus, many species can be missed easily. Were it not for the discovery of the small forest pond at NTL, our tally for species at that locality would have been 63 instead of 79, and five species, including a new species of *Phyllomedusa*, would not have been recorded from northern Loreto.

COMPARISON OF STUDY ZONES

Sampling effort and protocol in the study zones at SJ and NTL were essentially equal, and most of the specimens were collected or observed in the study zones. Thus, more detailed analyses of the anurans and lizards in these zones are possible. A total of 48 species of anurans was found in the two study zones. Of these, 20 (42%) were found at both sites; 13 species (27%) were found only at SJ, and 15 species

(31%) only at NTL. Among the 20 species common to both sites, there is a striking difference in the relative abundance (= frequency of capture and/or observation) of species (Fig. 21). An R X C test of independence (Sokol and Rohlf, 1981) shows a significant difference in relative frequencies between sites ($G = 149.47$, $df = 19$, $P < 0.001$).

A total of 21 species of lizards was found in the two study zones. Of these, 11 (52.3%) were found at both sites; six species (28.6%) were found only at SJ, and five (23.8%) only at NTL. Slight differences are evident in the relative abundances of the 11 species common to both sites (Fig. 22). An R X C test of independence (Sokol and Rohlf, 1981) reveals no significant difference between the sites ($G = 6.15$, $df = 10$, $P > 0.05$).

Based on the taxonomic composition and relative abundance of species, repeated sampling success can be predicted

Table 2. Species of amphibians and reptiles at three sites. Abbreviations in headings to columns correspond to sites in first column. The uppermost of the three numbers in each cell is the total herpetofauna, the middle number in each cell is that of anurans, and the lowermost number is that of lizards. The number of species at each site is shown in boldface in the common cell; the numbers of species that are in common to two sites are in the upper right, and the coefficient of biogeographic resemblance is in italics in the lower left.

SITE	SJ	TL	NTL
San Jacinto (SJ)	75	25	44
	44	20	27
	17	6	11
Teniente López (TL)	<i>0.42</i>	43	27
	<i>0.52</i>	33	18
	<i>0.48</i>	8	7
1.5 km N Teniente López (NTL)	<i>0.56</i>	<i>0.46</i>	75
	<i>0.58</i>	<i>0.44</i>	45
	<i>0.67</i>	<i>0.56</i>	17

by application of the rarefaction algorithm (Krebs, 1989), which extrapolates the number of species expected in a given sample size. For anurans, the curve is higher for TL than SJ (Fig. 23). Thus in a sample size of 50 specimens, 17 species would be expected at SJ and 21 species at NTL, whereas in a sample size of 100, 24 species would be expected at SJ and 30 at NTL. A sample size of 25 individuals of lizards from either site would be expected to contain 12 species.

Differences in species composition and relative abundances among anurans between the study zones seems to be attributable mostly to the presence of the lagoon at SJ. Several species of anurans (*Bufo marinus*, *Hyla albopunctulata*, *H. calcarata*, *H. granosa*, *Scinax garbei*, and *Rana palmipes*) not present at NTL were found only in that part of the study zone bordering the lagoon. The abundance of other species (*Hyla lanciformis*, *H. leucophyllata*, *Phyllomedusa vaillanti*, *Leptodactylus pentadactylus*, and *Physalaemus petersi*) at SJ was increased by their presence mainly near the lagoon. Thus, the presence of a breeding site utilized by many species of frogs skewed not only the presence, but also the abundance, of species at SJ. On the other hand, throughout the hilly region in the study zone at SJ fewer species of anurans (27) were found than in the equally hilly study zone at NTL (35).

The relative abundance of anurans with respect to diel activity and microhabitat differs between the study zones (Fig. 24). At both sites, the percentages of individuals that are nocturnal/arboreal and nocturnal/terrestrial are about equal, but these values are 44.6% and 41.2% respectively at SJ and 26.8% and 27.5% respectively at NTL. On the other hand, at SJ only 14.2% of the individuals are diurnal/terrestrial, as contrasted to 45.8% at NTL. This discrepancy, which also is reflected in the different percentages of nocturnal individuals at the two sites, is owing to the fact that

at NTL the three most abundant species (*Bufo typhonius* "A", *B. typhonius* "C", and *Epipedobates zaparo*), which make up 33.6% of the total, are diurnal/terrestrial, whereas at SJ the most abundant species (*Physalaemus petersi*, 28.8%) is nocturnal/terrestrial, and the next two most abundant species (*Phyllomedusa vaillanti*, 13.3%, and *Hyla calcarata*, 10.2%) are nocturnal/arboreal.

Discrepancies exist between the two study zones with respect to diel activity and microhabitat among lizards

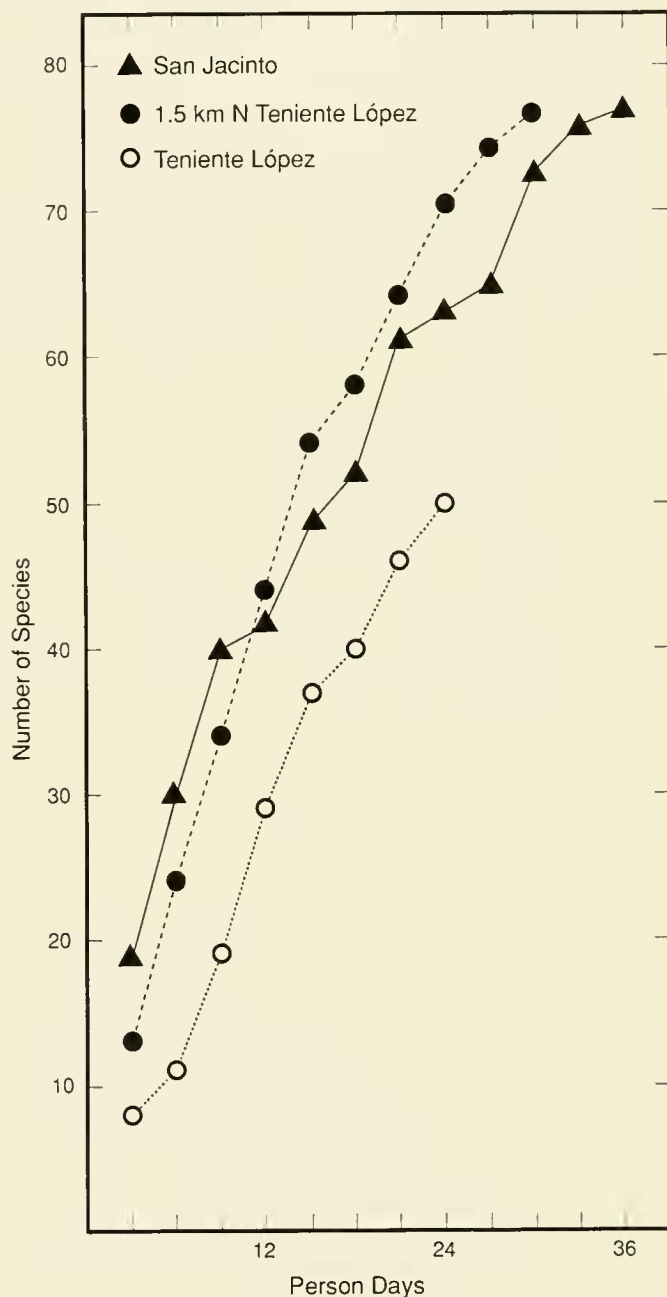


Fig. 20. Species discovery rates at three sites.

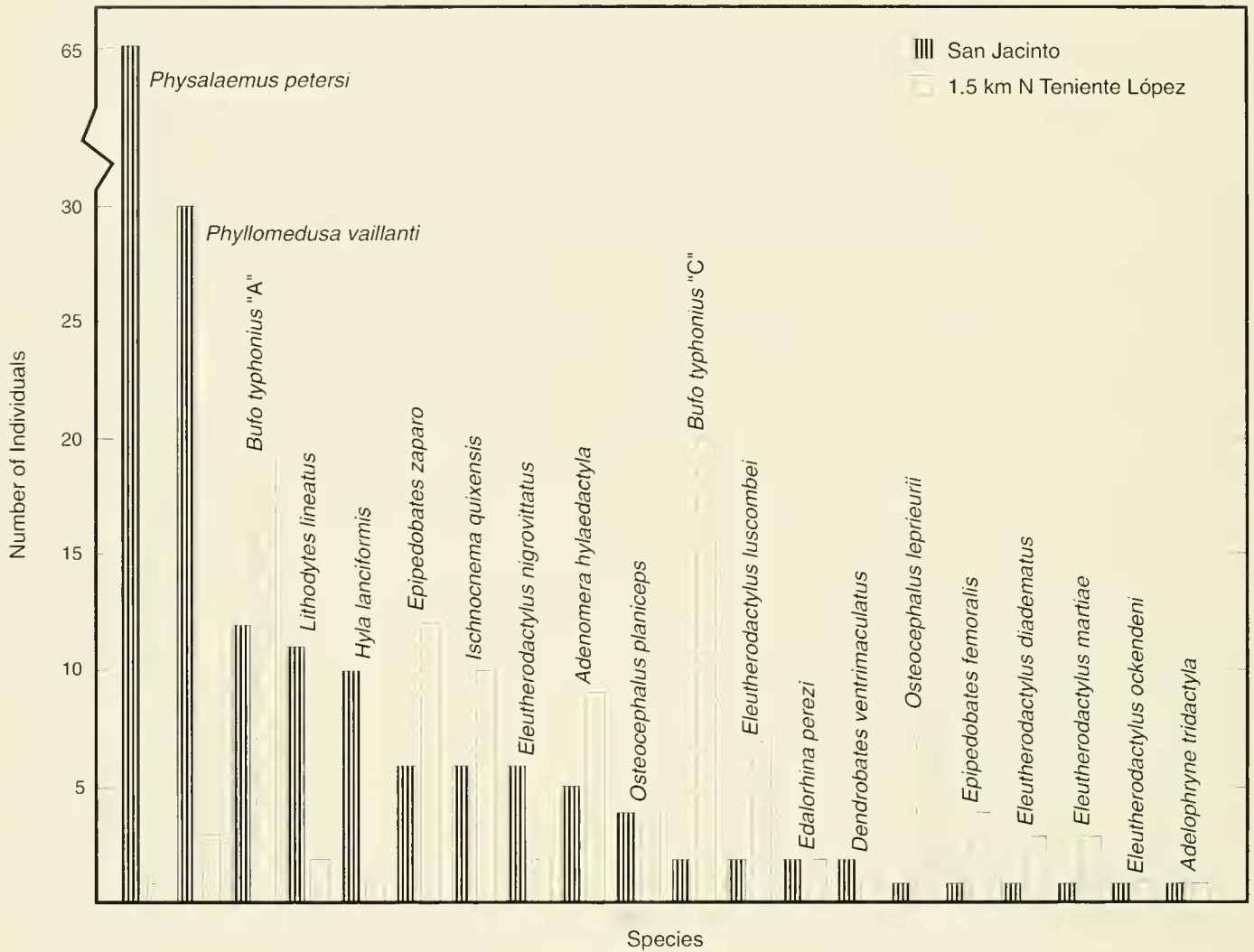


Fig. 21. Relative abundance of species of anurans in common to study zones at San Jacinto and at 1.5 km N of Teniente López.

(Fig. 25). Twice the percentage of diurnal/arboreal lizards (50% vs 25%) exists at SJ than as compared with NTL, and the percentage of diurnal/terrestrial lizards is greater at NTL (72.2%) than at SJ (47.4%). These differences are because of relative abundances of the most common species at the two sites—the diurnal/arboreal *Anolis fuscoauvatus* (28.9% of total) at San Jacinto and the diurnal/terrestrial *Kentropyx pelviceps* (19.4%) at NTL. Only one lizard, *Thecadactylus sapicauda*, is nocturnal/arboreal; it is represented by one individual from each study zone.

The total mass of anurans is much higher at SJ (1307.5 g) than at NTL (658.7 g), but 240 g of this mass at SJ is one *Bufo marinus*. This species usually inhabits open, disturbed areas, such as the camp clearing; one large adult was in a pitfall trap in the quadrat closest to the clearing (and lagoon) and presumably wandered into the forest or swam across

the lagoon. If that individual is removed, the total mass for SJ is 1067.5 g, and the mean mass per individual is 4.74 g, only slightly higher than the mean mass (4.33 g) for anurans at NTL. The total mass of lizards is 455.2 g at SJ and 342.9 g at NTL, and the mean mass is 11.98 g and 9.80 g, respectively.

When the single *Bufo marinus* is excluded, the distribution of mass among different diel activities and microhabitats roughly approximates the abundance of individuals (Table 3). For example, the two most common anurans (*Bufo typhonius "A"* and *B. typhonius "C"*) at NTL have a combined mass of 257.9 g and make up 39.2% of the total mass of anurans and 97.9% of the mass of diurnal/terrestrial anurans there; the other six diurnal/terrestrial species represented by 31 specimens have a combined mass of only 5.6 g. At SJ, where the greatest amount of mass is of nocturnal/arboreal

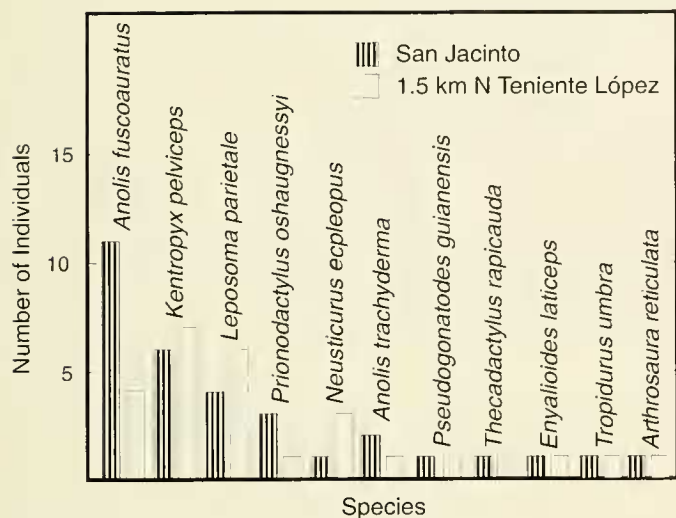


Fig. 22. Relative abundance of species of lizards in common to study zones at San Jacinto and at 1.5 km N of Teniente López.

anurans, the two species in this category (*Hyla lanciformis* and *Phyllomedusa vaillanti*) have a combined mass of 446.3 g and make up 41.8% of the total mass of anurans and 85.2% of the mass of nocturnal/arboreal anurans there; the other 15 nocturnal/arboreal species represented by 71 specimens have a combined mass of only 77.8 g. The most common species of anuran at SJ, *Physalaemus petersi*, is nocturnal/terrestrial; its mass of 87.0 g accounts for only 8.1% of the total mass of anurans at SJ.

Mass of lizards with respect to diel activity and microhabitat is proportionately the same at SJ and NTL. At both sites, *Kentropyx pelviceps* accounts for greatest amount of mass of lizards. At SJ and NTL, it accounts for 46.4% and 49.3% of the total mass of lizards, respectively, and 86.6% and 87.0% of the mass of diurnal, terrestrial lizards, respectively. The most abundant species at SJ is the small, diurnal/arboreal *Anolis fuscoauratus*, which accounts for only 2.4% of the total mass of lizards and 6.0% of the mass of diurnal/arboreal lizards there. Certainly, here is a case of abundance not correlating with mass; mean mass of other diurnal/arboreal lizards at SJ is 21.5 g; these include small species, such as *Anolis trachyderma* and *Gonatodes concinnatus*, and large species, such as *Enyalioides cofanorum*, *E. laticeps*, and *Tropidurus umbra*. Likewise at NTL, *Anolis fuscoauratus* is the most abundant diurnal/arboreal species, but it accounts for only 1.4% of the total mass of lizards and 4.1% of the mass of diurnal/arboreal lizards there.

Most anurans and lizards are feeding generalists on a variety of arthropods. Although most frogs include ants in their diets, some species are ant-specialists. These include the diurnal/terrestrial dendrobatids, members of the *Bufo typhonius* complex, and some small leptodactylids, as well as the nocturnal/terrestrial microhylids. One species included here, *Physalaemus petersi*, feeds almost exclusively on ter-

mites; it is represented by 65 individuals (87 g, 8.1% of total anuran mass) at SJ but only one individual (1.4 g, 0.2% of total anuran mass) at NTL. Nine ant-specialists are present at SJ and NTL; they are represented by 33 and 72 specimens, respectively. These nine species account for 144.5 g (13.5% of total anuran mass) at SJ and 284.7 g (43.2% of total anuran mass) at NTL. The discrepancy mostly is owing to the fact that two of these species at NTL (*Bufo typhonius* "A" and *B. typhonius* "C") are the two most abundant species in our samples. By excluding the data on these two species at both sites, the difference in mass of ant-specialists is far more similar between the sites—13.8 g (1.3% of total anuran mass) at SJ and 26.8 g (4.1% of total anuran mass) at NTL.

Among the lizards found in the study zones, all are feeding generalists, except two diurnal/arboreal species, *Tropidurus plica* and *T. umbra*, which are ant-specialists. One *T. plica* was found at NTL; its mass of 81.0 g is 23.6% of the total lizard mass at that site. One *T. umbra* was found at each site; the individual from SJ had a mass of 15.5 g (4.1% of the total lizard mass), and the one from NTL had a mass of 16.5 g (4.8% of the total lizard mass).

COMPARISON WITH OTHER REGIONS

Although our collections from the sites in northern Loreto are far from complete, it is possible to make some meaningful comparisons with the herpetofaunas from other

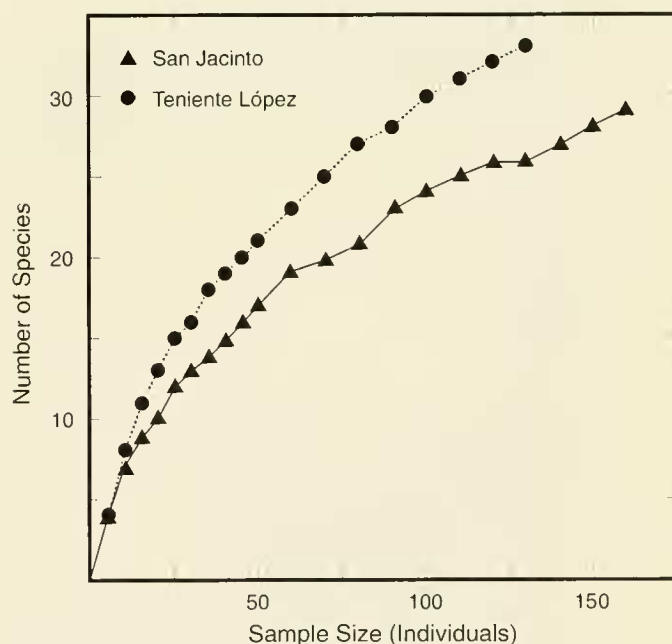


Fig. 23. Projected rarefaction curves for anurans based on species and their abundance at the study sites. The curve for lizards at both sites approximates the base of the curve for anurans at San Jacinto.

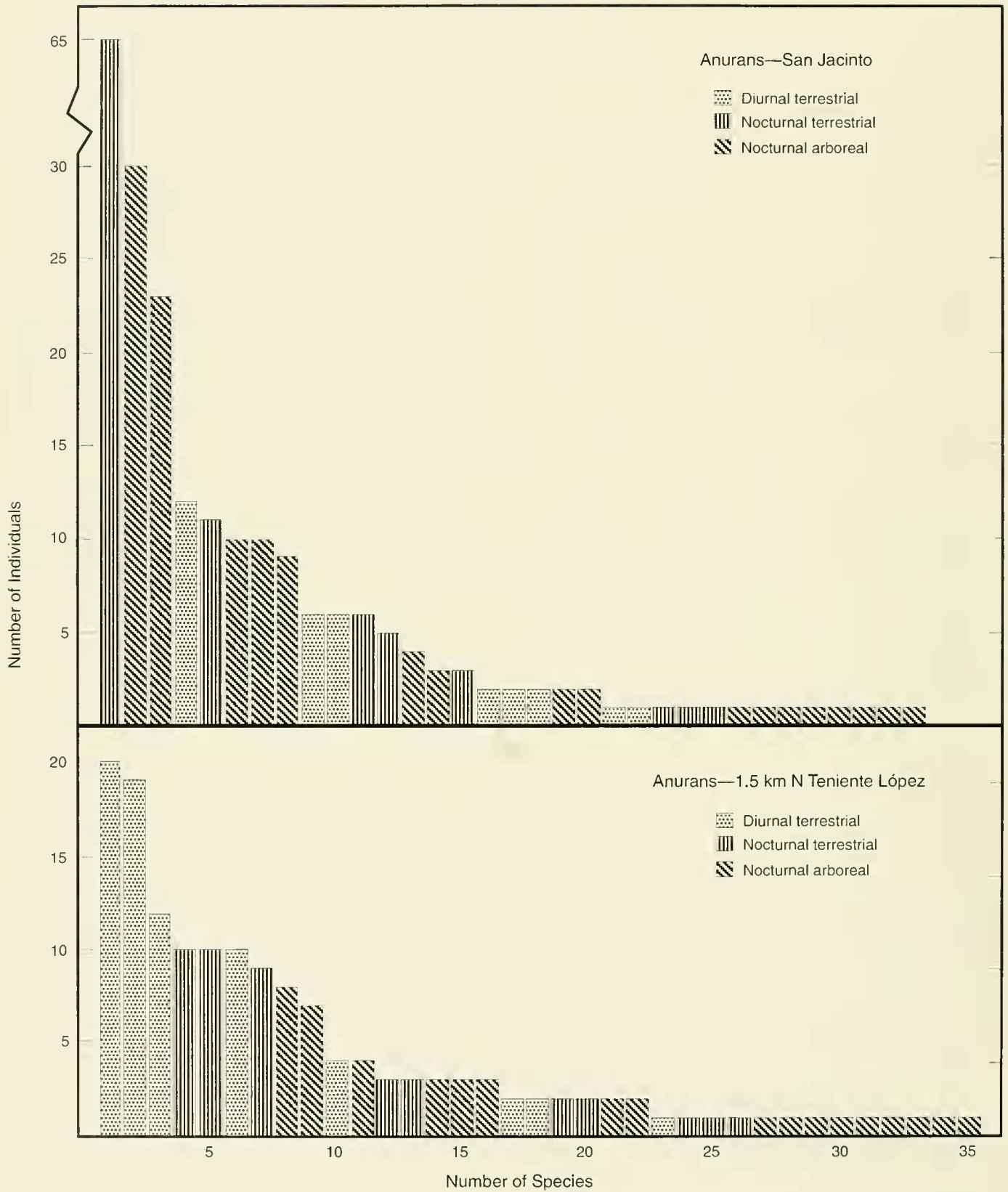


Fig. 24. Comparative abundance of anurans with respect to microhabitat in the study zones at San Jacinto and at 1.5 km N Teniente López. Each bar represents a different species.

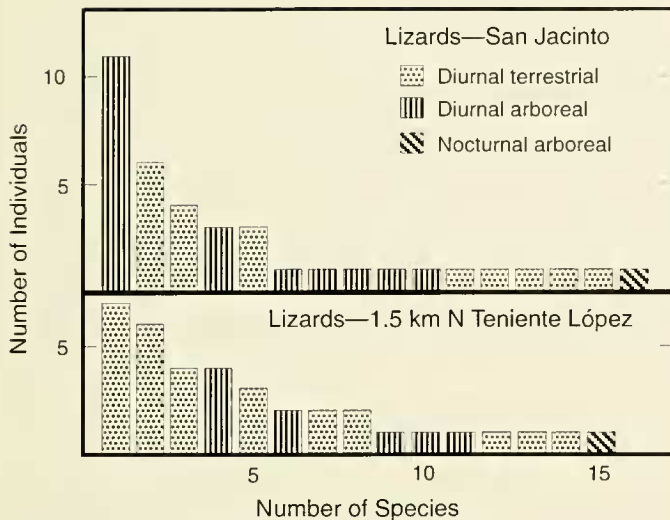


Fig. 25. Comparative abundance of lizards with respect to microhabitat in the study zones at San Jacinto and at 1.5 km N Teniente López. Each bar represents a different species.

sites in the upper and central Amazon Basin. The sites are:

Santa Cecilia, Ecuador.—A site at 340 m on the Río Aguarico (00°03' N, 76°59' W); aseasonal lowland tropical rainforest with a herpetofauna of 177 species (data updated from Duellman, 1978).

Cocha Cashu, Peru.—A site at 300–400 m on the Río Manu (11°54' S, 71°22' W); seasonal lowland tropical rainforest with a herpetofauna of 146 species (Rodríguez and Cadle, 1990).

Cuzco Amazónico, Peru.—A site at 220 m on the Río Madre de Dios (12°05' S, 69°05' W); seasonal lowland tropical rainforest with a herpetofauna of 145 species (Duellman and Salas, 1991).

Manaus, Brazil.—The Minimum Critical Size of Ecosystems study sites (02°20' S, 60°00' W), 70–90 km N Manaus; seasonal lowland tropical rainforest with a herpetofauna of 128 species (Zimmerman and Rodrigues, 1990).

As shown in Table 4, the similarities among anurans and lizards is high between northern Loreto and Santa Cecilia (CBRs = 0.67 and 0.68, respectively). These similarities are exceeded only by that of anurans (CBR = 0.71) between Cocha Cashu and Cuzco Amazónico and approximated by that of anurans (CBR = 0.63) between Cocha Cashu and Santa Cecilia and that of lizards (CBR = 0.61) between Cocha Cashu and Cuzco Amazónico. The similarities between Cocha Cashu and Cuzco Amazónico are expected be-

cause of their close proximity (260 km apart) in the same drainage system. Likewise, the northern Loreto sites are separated from Santa Cecilia by a distance of about 280 km, but they are in different drainage systems. With the exception of the low similarity of lizards (CBR = 0.38) between Cuzco Amazónico and northern Loreto, the similarities of both anurans and lizards are much lower (CBR = 0.33–0.42) between Manaus and all other sites. A distance factor may be significant here; Manaus is separated from all of the other sites by distances of more than 1500 km. In comparison with the other sites (all in the upper Amazon Basin), the herpetofauna at Manaus is depauperate. Moreover, similarity between Manaus and the upper Amazonian sites is exaggerated negatively by the presence at Manaus of several species (e.g., *Chiasmocleis shudikarensis*, *Pipa aravali*, and *Leptosoma guianense*) that are principally Guianan in distribution.

The intermediate geographic location of the sites in northern Loreto between Santa Cecilia to the north and Cocha Cashu and Cuzco Amazónico to the south is reflected in the composition of the herpetofauna. Many of the species occur at all of these sites in the upper Amazon Basin, but others reach either their northern or southern limits of distribution in Loreto. Those reaching their southern limits include *Hyla albopunctulata*, *Eleutherodactylus quaquaversus*, *Chiasmocleis bassleri*, *Anolis transversalis*, and *Enyaliodes cofanorum*, whereas *Hyla koehlini*, and *Eleutherodactylus malkini* reach the northern limits of their distributions in the region.

Two species found at NTL have affinities with the Andean slopes. *Phyllomedusa hulli* is a member of the *Phyllomedusa buckleyi* group, which otherwise occurs on the slopes of Andes, the Cordillera de la Costa in northern Venezuela, and in Central America (Cannatella, 1980). Except for the record from NTL, *Alopoglossus copii* is known only from the Andean slopes of Ecuador (Ruibal, 1952; Peters and Donoso-Barros, 1970). Specimens assigned to that species from Santa Cecilia in the Amazon Basin in Ecuador (Duellman, 1978) have been reidentified as *A. angulatus*.

Two species that are widespread in the Amazon Basin, *Bufo marinus* and *Ameiva ameiva*, characteristically inhabit disturbed areas and clearings; they seldom venture far into closed forest. Their principal avenues of dispersal seem to be major rivers, which have broadly exposed banks during the dry season, and roads. *Bufo marinus* was present in the camp clearings at SJ and TL, but *Ameiva ameiva* was not observed at either site, nor was it observed along roads or at Andoas, which has extensive clearings along a major river, the Río Pastaza.

Table 3. Percentages of individuals and mass (in parentheses) of anurans and lizards with respect to diel activity and microhabitat in study zones at San Jacinto (SJ) and at 1.5 km N Teniente López (NTL).

DIEL/MICROHABITAT	ANURANS				LIZARDS			
	SJ		NTL		SJ		NTL	
Diurnal/terrestrial	14.2	(11.0)	45.8	(44.0)	47.4	(53.6)	72.2	(56.7)
Diurnal/arboreal	0.0	(0.0)	0.0	(0.0)	50.0	(40.2)	25.0	(35.7)
Nocturnal/terrestrial	41.2	(39.9) ¹	27.5	(29.8)	0.0	(0.0)	0.0	(0.0)
Nocturnal/arboreal	44.6	(49.1)	26.8	(26.2)	2.6	(6.1)	2.8	(7.6)

¹ Exclusive of *Bufo marinus*.**Table 4.** Species of anurans and lizards in five regions in Amazonia. Abbreviations in headings to columns correspond to regions in first column. The upper number in each cell refers to anurans; the lower number refers to lizards. The number of species in each region is shown in boldface in the common cell; the numbers of species that are in common to two regions are in the upper right, and the coefficient of biogeographic resemblance is in italics in the lower left.

REGION	SC	NL	CC	CA	MA
Santa Cecilia, Ecuador (SC)	81	49	51	42	26
	30	18	16	16	9
Northern Loreto (NL)	<i>0.67</i>	66	37	33	21
	<i>0.66</i>	24	14	9	9
Cocha Cashu, Peru (CC)	<i>0.63</i>	<i>0.51</i>	80	51	21
	<i>0.57</i>	<i>0.56</i>	26	16	10
Cuzco Amazónico, Peru (CA)	<i>0.58</i>	<i>0.51</i>	<i>0.71</i>	64	20
	<i>0.61</i>	<i>0.38</i>	<i>0.65</i>	23	10
Manaus, Brazil (MA)	<i>0.42</i>	<i>0.39</i>	<i>0.34</i>	<i>0.38</i>	42
	<i>0.33</i>	<i>0.38</i>	<i>0.40</i>	<i>0.42</i>	24

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